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A Comparative Study of Achievement in Country and Town Schools

By Norman Frost, Ph.D.

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N. F.

CONTENTS

A COMPARATIVE STUDY OF ACHIEVEMENT IN COUNTRY AND TOWN SCHOOLS

CHAPTER I

PREVIOUS OBJECTIVE STUDIES OF ACHIEVEMENT IN COUNTRY SCHOOLS

AN accurate comparison of school systems in objective terms is necessary for the proper solution of problems in regard to the organization and administration of schools. Such a comparison is made possible by the use of standardized tests in the systems to be compared, and has been made with great profit in many city school systems. To a much more limited extent the same kind of comparisons have been made among rural schools.

The *Ohio Survey Commission Report,* 1914, on pages 133 and 134, reports the median score on the Hillegas scale of 97 eighth grade composition papers from Delaware (city) as 521.6, and the similar median of 118 eighth grade composition papers from Delaware (county) is reported as 387.6. On pages 135*ff*. of the same report results of handwriting scores by the Ayres Scale are given. These results are from 1,397 pupils in 176 rural schools in 21 counties in Ohio; from 214 pupils in the three upper grades of the rural schools of Delaware County; from 312 pupils in the three upper grades in the city schools of Delaware; and from a small city in Iowa, based on results obtained by I. King and H. Johnson, whose study was originally published in the *Journal of Educational Psychology* (III: 514-520). Tables are given which show, among other things, that in the small Iowa city 98 per cent of the eighth grade papers were scored over 50 on the Ayres Scale; that 77.8 per cent of the like papers from the Ohio rural schools made like scores; 73.5 per cent from the Delaware County (rural); and 91.3 per cent from the city of Delaware. In conclusion it is stated that "the handwriting in both Delaware city and Iowa city is on the whole better than in the rural schools . . ." and that "there is greater uniformity in the city schools."

Results of work with the Courtis Standard Research Tests in Arithmetic Series B and Starch's Arithmetical Scale A are reported on pages 33*ff*. of *A Study of Rural Schools in Travis County,* Bulletin of the University of Texas, December, 1916. Tables are given showing grade results of the Courtis tests, and the discussion is sum-

marized in this statement: "In every instance the number of examples attempted and the number of examples worked correctly were lower in this group of country schools than for the corresponding grades in Boston and Detroit, and among the 11,800 pupils tested in Iowa. Sometimes this difference was as great as 50 per cent, the average difference being approximately 25.5 per cent." Concerning the results of the Starch test the following statement is made: "As a test for the reasoning ability of these pupils on arithmetical problems, Starch's Arithmetical Scale A was used. The results from the fourth to the eighth grade were duly tabulated. Each grade scored below the scale standard established for it. The fourth grade was 11 per cent below standard; the fifth grade 19 per cent; the sixth grade 5 per cent; the seventh grade 6 per cent; and the eighth grade 8 per cent."

In 1916 the State Board of Education in Connecticut made a number of studies of the schools in certain of the towns (townships) of that state. The tests used were not standardized, but they were uniform for all of these investigations. The subjects covered were arithmetic, reading, language, history, geography and spelling. Comparative tables for different towns in the state are given in these reports, which were published separately as bulletins of the Connecticut State Board of Education. The following quotations give an idea of the character of the findings: "The accomplishment of the pupils as shown by the tests given is only from fair to poor. Especially is this true in view of the retardation in the schools." (*Educational Enquiry,* Trumbull, p. 29.) "While the results in this fundamental test are not satisfactory, they nevertheless compare favorably with the work of pupils in the towns of Seymour, Westbrook and Bloomfield." (*Educational Enquiry,* New Hartford, p. 24.) "It would appear from the above that the children cannot add with facility and accuracy, although some progress is being made from grade to grade." (*Educational Enquiry,* Seymour, p. 23.) "It is obvious that most pupils in these towns are unable to interpret and solve correctly simple problems." (*Educational Enquiry,* Westbrook, p. 25.)

In an unpublished survey of the Haldane school, Cold Springs, N. Y., made in 1917, a table on page 30 gives a comparison of median achievements in English composition by grades (Hillegas Scale, Nassau County Extension), which includes grade medians for the schools of Mobile County, Ala., and for the city of Mobile. In every grade reported the median for the city schools is higher than that for the country schools.

The Survey and Report of The Virginia Public Schools Education Commission, published in 1919, gives comparative results for country and city schools for the following tests: Thorndike Reading Scale A2, Virginia Reading Test Sigma 8, Virginia General Examination Exercise 1, Ayres Spelling Scale, Starch Scale for Measuring Handwriting, Woody Arithmetic Scale Series B, Courtis Standard Research Test in Arithmetic Series B, and the Nassau County Supplement to the Hillegas Scale for Measuring English Composition. About sixteen thousand different children were examined with from six to forty different tests. Of these sixteen thousand children about five thousand were in grades three to seven of rural white schools. The general character of the results is indicated by the following quotations from the report: "In summary it may be said that the condition of reading in the Virginia city schools is fairly satisfactory. Such deficiencies as do exist will be easily adjusted when once attention is called to them. In the rural schools, however, there is a deficiency that should be met by vigorous remedial measures." (p. 121.) In regard to handwriting the report has this to say: "The scores for rural schools having four or more rooms compare favorably with those for city schools, and the progress is regular from grade to grade. The average progress is four-tenths of a scale step per year, which is less than it should be by Starch Standards. The one-room country school shows the poorest record." (p. 122.) In regard to spelling it says: "The most notable deficiencies are in the one-room school (all grades) and in the seventh grade for every group tested. In three cases the deficiency is a year or more of progress as measured on the Ayres Scale." (p. 123.) Concerning arithmetic the report states that "The average seventh grade score for Virginia city children at the end of the year is 15.9, which is the sixth grade Woody Standard for the beginning of the year, and it is 15.1, or less than the sixth grade Woody Standard for the seventh grade in the best graded rural schools. For the one-room rural schools it is only 13.5." (p. 124.) "What is true of addition is generally true of the results in subtraction, multiplication and division." (p. 125.) In general conclusion in regard to the results in rural schools the report says: "The inferiority of the small rural school is apparent from the figures given. In reality that inferiority is even greater since in all non-city schools children are on the average about a year older than city children and in the one-room schools children are on the average about a year and a half older than city children in each of the upper grades of the elementary schools. In arithmetic the

inferiority of the one-room school is perhaps most marked, children in such schools being on the average one grade behind children in the larger non-city schools." (p. 129.)

E. H. Taylor, in an article, "A Comparison of the Arithmetical Abilities of Rural and City School Children," published in the *Journal of Educational Psychology* (V: 461-466, October, 1914), reports the results of Courtis arithmetic tests given by himself and the county superintendent to most of the children in a county in Illinois. Tests were given to 309 children in 28 schools. Results are tabulated and compared by grades with scores of 7,008 children, published by Courtis in *Elementary School Teacher* (XII: 133*f*). The comparison shows that the rural schools are consistently below the others; grades 3 and 4 of the rural schools are approximately a grade below, grades 5 and 6 are almost two grades below, grade 7 is more than one grade but less than two grades below, and grade 8 is at least two grades below.

Richard Zeidler reports in *Elementary School Journal* (XVI: 542-555) tests of efficiency in the rural and village schools of Santa Clara County, California. Courtis arithmetic tests were given by the writer to 587 children in grades 5 to 8 inclusive. Results are compared with a group of 20 small Western cities, with Salt Lake City, and with Butte. The writer concludes that "From these tables it will be noted that rural and village schools in Santa Clara County, in every subject and in every grade, fall below the median scores for the cities. This inferiority ranges as high as 600 per cent, as is shown in division in the fifth grade of Santa Clara County compared with the fifth grade division in Salt Lake City, Utah. It must be admitted, however, that Salt Lake City has an enviable record." ". . . It will be seen that rural and village schools of Santa Clara County fall, on the average, fully two grades below Salt Lake City, and one grade below the twenty small cities."

The same author reports tests in silent reading in the rural schools of Santa Clara County, California, in *Elementary School Journal* (XVII: 55-62). Starch Reading Tests were given by the writer in 26 rural schools. Eight of these schools were one-teacher schools, 7 were two-teacher, 7 were three-teacher, and 4 had more than three teachers. The results are tabulated in detail, and compared with results from San José. Mr. Zeidler says: "In comparing the median number of words read per second in the rural schools with the medians for the San José schools, it will be seen that the rural schools compare very favorably with the city schools. The fifth grade

falls 2/10 below, while the seventh and eighth grades score higher than the city schools of that community. But if we make a comparison of both the rural schools of Santa Clara County and the city schools of San José with the standardized scores, we find that both fall below, with the single exception of the seventh grade in the rural schools, which surpasses the standards by 1/10." "In the reproduction of the thought, the rural school children fall below the children of the city of San José. There is a marked difference in the third grade, where the median for the rural schools is 7.5 as against 12.5 in the city."

Charles L. Harlan is the author of "A Comparison of the Writing, Spelling and Arithmetic Abilities of Country and City Children," published in *Educational Administration and Supervision* (II: 560-573). Tests were given to 359 pupils in 21 rural schools in a "typical" county in Pennsylvania. Handwriting was scored on the Ayres Scale and compared with Freeman's average based on a study of handwriting in 56 cities. No material difference appears between the results in Mr. Harlan's study and the averages obtained by Freeman, either in the quality or the speed of writing. Three hundred and thirty-seven pupils were tested in spelling, words being used from the Ayres list. Results are tabulated, and Mr. Harlan concludes: "A comparison of the above averages shows an advantage of from seven to fourteen words per one hundred in favor of the city pupils. The country averages are uniformly lower than the city averages. This is no mere statistical accident. The pupils of the rural schools do not spell as well on written tests as do the children of the city schools." Courtis Arithmetic Tests Series B were given to 255 pupils. The comparison is with the Courtis Standards. "In summarizing, one may say that in the fundamental operations of arithmetic the pupils of the rural schools rank approximately two grades below the pupils of the city schools." "The improvement in arithmetic from grade to grade is less for country children than for city children."

M. E. Haggerty, in *Studies in Arithmetic,* Indiana University Studies, No. 32 (September, 1916), reports results from 5 counties in Indiana. Results are tabulated, and it is concluded that "These data point to the conclusion that the district schools are more efficient in procuring achievement in the function measured than the graded." (p. 68.) This is the only study found that reports an actual advantage in favor of the rural school. Mr. Paul Mort is directly responsible for the data collected. It is not definitely stated how the material

given in this study was gathered, but it is to be inferred from the extent of the study that the testing was done by the teachers.

In *A Report on the Use of Some Standard Tests,* Wisconsin State Department of Public Instruction Studies in Educational Measurements in Wisconsin, Bulletin No. 1, W. W. Theisen reports results for 36,564 children in Wisconsin, of whom 15,825 were in rural schools. He summarizes on page 22 as follows: "Judged by the Ayres standards, rural children in Wisconsin do not spell well. They average not less than 10 points below the standard in every grade. However, when compared with other classes of Wisconsin schools, as will be seen from Table 1, they are not conspicuously poorer nor better spellers than the pupils in the cities and villages."

The same author in the same report gives results of penmanship scored according to the Thorndike Handwriting Scale from 141 rural schools in 28 counties. He summarizes (p. 85): "Rural schools on the whole make the best showing of Wisconsin schools in writing. Their quality is not inferior to that of other classes of schools, and their speed is more nearly in accord with desirable standards in most grades."

The *Sixty-Ninth Report of the Public Schools of the State of Missouri* (June 30, 1918) reports a series of investigations as to rural school conditions in that state. Courtis Standard Reading Test No. 2 was given to 6,056 pupils in 547 schools in 82 counties. Among the findings it is stated (p. 74) that "A second observation based on the table is that in all three phases of reading ability the rural school children in these grades (2-8) are below the standard set by Courtis."

The Kansas City Scale for Measuring Handwriting was used for scoring papers of about 8,000 pupils in 86 counties in the same state. The results are reported in detail by grades, and it is concluded (pp. 80-81) that "The quality or form of handwriting of the rural school pupils is far below the accepted standards, grade for grade. The speed is above the accepted standards, except in the seventh and eighth grades."

Results are also reported from 6,445 pupils in grades 4 to 8 inclusive and from 87 counties for the use of Courtis Standard Research Tests in Arithmetic, Series B. (pp. 81-85.) It is concluded that "On the whole the rural school children in Missouri are not up to the ability of the city pupils as shown by the Courtis general tabulations. This is particularly true of the sixth, seventh and eighth grades. In the eighth grade it was pointed out that the Missouri rural school pupils were below in every particular."

In the same report (pp. 85-87) results are given for a spelling test based on the Ayres' Spelling Scale given to 8,326 pupils in 611 schools in 86 counties. In conclusion it is stated (p. 87) that "The rural school pupils in Missouri are below the standard attainment for the city school pupils in 84 of the larger cities of the United States, and the writer of the report of which this section is a summary says also that the rural school pupils are below the attainment of the ten town schools in the state studied by him."

In 1918, in *Report on Spelling and Penmanship in Country Schools,* Louisiana State Department of Education, Bulletin No. 1, June, 1918, John M. Foote reported the results of spelling test from the Ayres list given to 4,584 pupils in rural schools in Louisiana. He concludes (p. 11) that: "While it may be that the superiority of the large type of school as compared with the small type is decisively reflected in the instruction in some of the subjects taught, it must be concluded that in so far as spelling ability in the rural schools is concerned no such decisive difference exists. The results show clearly that there is a difference in favor of the large school, but the assumption that the classroom results are very much better is not warranted."

The same author in the same bulletin reports handwriting results according to the Ayres Scale for 4,073 pupils in 114 rural schools, and concludes (p. 24) that "It will be seen by reference to the table and diagram that there is comparatively little difference in both quality and speed between the five groups. It will be noted that the difference in quality is less than in speed. The situation is similar to that found in spelling. The evidence therefore points to the conclusion that the pupils in the large schools are slightly superior, but that no great difference prevails."

The same author, in *Silent Reading in Rural and Village Schools,* Louisiana State Department of Education, Bulletin No. 9, July, 1919, reports results from work with Monroe's Standardized Silent Reading Tests with 4,315 pupils in 96 schools located in 15 parishes. He concludes (p. 8) that "A comparison of the three groups A, B, and C reveals a distinct difference in favor of the larger school. With the exception of the fourth grade the scores of group B are better than those of group C. Group A scores are higher in every instance than groups B and C. This superiority of the large type of school is in agreement with results reported for Santa Clara County, California."

Still later, in *A Study of Arithmetic in Rapides Parish,* Louisiana State Department of Education, Bulletin No. 11, September, 1919, Mr.

Foote reports results for the use of the Courtis Arithmetic Test Series B in the schools of Rapides Parish, Louisiana. In this study schools are grouped in four classes, those in the city of Alexandria in group A, eight high schools in group B, eight graded schools in group C, and twenty-eight one- and two-teacher schools in group D. Mr. Foote concludes (p. 12) that "Superior results are obtained in the large type of schools." (p. 13.) "Group A and D vary in speed by 1.0 year and in accuracy by 2.0 years. It is therefore evident that the large schools as represented by groups A and B obtain results that are distinctly superior to those obtained by groups C and D."

George A. Grim, in "Spelling in Northampton County," *University of Pennsylvania Bulletin,* Vol. XX, No. 1, October, 1919, Sixth Annual Schoolmen's Week Proceedings, reports spelling results for the rural and urban sections of Northampton County. The results are reported for grades 2 to 8 inclusive, and in five of the seven grades reported the urban schools surpass the rural. The differences reported are not great in any case.

Cyrus D. Mead, in *The Spelling Ability of the Plumas County Children,* California State Board of Education, Supplement of California Blue Bulletin, December, 1919, reports on the spelling ability of the pupils of Plumas County, California, as shown by a test from the Ayres list. He concludes (p. 5) that "The pupils of this county are . . . just about of the average ability of city children over the country."

The above references include all the data easily available dealing in an objective way with the comparative results of instruction in rural and in urban schools. The difficulty of collecting data in rural schools, where distance is great and classes small, makes the time element in collecting any large number of cases very great and seems to have prevented the collection of extensive material. The studies reported include 2 studies of composition work; both of these favor the urban school. There are 6 studies of handwriting reported, and of these 3 favor the urban school, 2 show negligible differences, and 1 favors the rural school. Nine studies of arithmetic are reported, and 8 of these favor the urban school, while 1 favors the rural school. Four studies of reading are reported, and all of them favor the urban school. Seven studies of spelling are reported, 3 of which favor the urban school and 4 of which find negligible differences. In all 28 studies are reported, of which 20 find the results better in urban schools, 6 find negligible differences, and 2 find results superior in the rural schools.

CHAPTER II

PURPOSE AND SCOPE OF THE PRESENT STUDY

THE studies of results of instruction in rural schools reported in Chapter I are in objective terms, and seem to indicate a situation that is quite generally inferior to that in cities and towns. All of the comparisons are made, however, upon a grade basis, which assumes that the third grade, or the eighth grade, or any other grade should be the same in one system as in another. That grades are not in fact equal is shown by results. Under the present diversity of conditions it is entirely possible that grades should not be equal.

Particularly is this true in country schools as contrasted with city schools. The shorter terms, poorer attendance, and inherent difficulties involved in the small school make it probable that grading in these schools should be different from that in city schools. For example, in Madison County, Kentucky, the school year for the smaller schools is only six months. This means that a boy or girl entering school at the age of six and progressing normally would at the age of fourteen complete the eighth grade, having attended school a total of 48 months. A child entering one of the larger schools of the country, such as that in Richmond, would have nine months' schooling each year, and would, if he progressed normally, complete the eighth grade with a total of 72 months in school; that is, with 24 months' more schooling than the country child received.

Again, in some of the states the school system is organized on the basis of seven grades in the elementary school, so that a direct comparison of a fifth grade in a seven grade system with a fifth grade in an eight grade system is impossible.

Further, the use of grade standards must assume that tests are given at the same time in the school year. This would be necessary either to compare the system tested with another system or with the work in the same system in other years, since the standard for any grade must be different at the beginning and at the close of the school year. It is not always convenient, or even possible, to give tests in any particular part of the school term. There will be material gain in the ease of using standard tests if it can be made possible to give them at any convenient time and to obtain results comparable with those from other places and given at other times.

Then, too, in any system of schools some pupils are likely to fail of promotion each year. This causes retardation, and is much more serious in some systems than in others. Any consideration of the efficiency of a school system must account for this factor. Grade standards do not do so.

It is for such reasons as these that the *Nassau County Survey,* published as a bulletin of the University of the State of New York (December, 1917), in reporting the measurements of the achievements of pupils, carefully refrains from making any comparison of the urban and rural schools, and makes the following statement (p. 146): "The classification of school districts by the approximate size of the schools has not been continued in this chapter, because of the possible injustice which might thereby be done to the small schools, in which the exact classification of pupils into eight grades is not always possible. There might have been possible a more accurate comparison of the results from large and from small districts, if the results had been tabulated by age rather than by school grade. A comparison of the ability children have in a rural school by the time they are 'twelve years old' with the ability of children of the same age in a large village school might possibly be more significant than a comparison of the ability between children of the 'sixth grade' in the two types of schools. For several reasons, however, we have not been able to make such comparisons between the achievements of pupils of the same ages in districts of various sizes."

To really measure school efficiency it is necessary to show the progress, not only of those who are promoted, but of all the children; and to do this in terms of some unit common to all schools, city or country, seven grade or eight grade system, and long or short school term. There will be added convenience if such a unit can be so devised as to be usable at any time during the school year.

The chronological age of school children is such a unit. If the progress made by children can be shown, say between the ages of 7 and 12, a measure that is definite, universal, and approximately equal at any time during the school year is obtained, provided only that children of both ages are tested at the same time. The question is whether such progress can be shown.

This study undertakes:

First, to show that the difference in performance in school subjects of children of different ages can be obtained;

Second, to show that this difference is a measure of school efficiency which may be used to measure schools or school systems;

Third, to apply this measure to a system of country schools;

Fourth, to compare the results in this country system of schools with the results in certain city school systems.

The country school system to which this measure is applied is that of Madison County, Kentucky. This county lies a little east of the central portion of the state, and includes both blue-grass and mountain land. In the 1910 census it ranks 20th in the land area among the counties of the state, 5th in the value of all farm property, and 12th in the value of all farm crops. Corn and tobacco are easily the leading crops. The county is one of the wealthier and larger counties of the state. There are two normal schools, the Eastern Kentucky State Normal at Richmond and a normal department in connection with Berea College at Berea. The number of public white schools is 68, six of which have three or more teachers and a term of nine months. The rest of the schools have only one or two teachers and a six-month school year. A county supervisor of schools is employed to assist the county superintendent. There is no reason to suppose that the schools of this county are particularly worse than those of surrounding counties.

For the purposes of this study three tests were selected: Trabue Completion-Test Language Scale B, Courtis Standard Research Tests in Arithmetic Series B, and Thorndike Silent Reading Scale Alpha 2. These tests were given in grades 3 to 8 inclusive of all the public schools for white children in the county during November and December, 1919.[1] The results are tabulated separately for the schools having a six-month term and for those having a nine-month term.

In order that the results in Madison County may be compared with results in other places, data are included as follows: From Louisville, Kentucky, data for each of the three tests used; from Paterson, New Jersey, and St. Paul, Minnesota, data for the Trabue Language Scale; from Louisiana, Arkansas City and Salina, Kansas, and Hibbing, Minnesota, data for the Courtis Standard Research Tests in Arithmetic Series B; from Hamilton Township, New Jersey, and Amsterdam, New York, data for Thorndike Silent Reading Scale Alpha 2.

In order to show clearly the method followed, the results of the Trabue Completion-Test Language Scale B are worked through in detail in the next chapter.

[1] Five of the one-teacher schools were not in session when visited, and no results from them are given.

CHAPTER III

ACHIEVEMENT MEASURED BY THE TRABUE LANGUAGE SCALE

TABLE I shows the age-grade distribution of scores made in the Trabue Language Scale B by pupils in the Madison County schools having a term of 6 months. The table reads as follows: There are 8 pupils 7 years of age in the third grade, 1 of whom made a score of 3, 2 a score of 4, 2 a score of 5, 3 a score of 6, etc. In this table and throughout the study the age used is that of the last birthday at the time the test was given. A child is considered as 10 years old who is as much as 10 years old and less than 11 years old.

It is evident from the total number of cases occurring for the respective ages that the distributions are incomplete for most ages; probably for all. There should be at least as many 8-year-old children, for example, as there are 9-year-olds. This incompleteness for the younger ages represents children in the first and second grades, which were not tested, or children who have not yet entered school. Since these children have not yet been promoted to the third or higher grades, it is evidently the opinion of the teachers that they could not do so well as the children who are in the third or higher grades. It follows that the distributions for children of the younger ages are lacking in the number of cases for the lower scores. The distributions for the older children, on the other hand, may be considered as lacking in the number of cases for the higher scores, since the older children not appearing in the table are those who have either completed the eighth grade before reaching the age indicated, or who have for some reason stopped attending school.

If the difference in performance in school subjects of groups of children of different ages is to be a valid measure of the efficiency of a school system, it is evident that the age-groups in the respective systems must be comparable. That is to say, either these groups must include all children of the age indicated, or the selection must be shown to be by random sampling only, or the selection must be shown to be influenced only by known causes acting equally and in the same direction, or it must be possible to so correct the age-groups given as to meet substantially the above conditions.

The age-groups presented in Table I do not meet the first of these

TABLE I: AGE-GRADE DISTRIBUTION OF TRABUE LANGUAGE SCALE B SCORES IN THE 6-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY. (NOVEMBER AND DECEMBER, 1919)

Age	Grade	Scores																			Total
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
7	3				1	2	2	3													8
	4	1				2	1	1	1												6
	5					1		1													2
Total		1			1	5	3	5	1												16
8	3	6		2	1	3	2	10		2	1										27
	4	1		1	1	3	1	7	4	1		1	1			1					22
	5							1		4											5
Total		7		3	2	6	3	18	4	7	1	1	1			1					54
9	3	6		6		12	2	9	3	2											40
	4	6		2		1	3	7	2	3	3	2	3		1						33
	5			1	1			4		7	4	1		1	1						20
Total		12		9	1	13	5	20	5	12	7	3	3	1	2						93
10	3	3	1	1	1	5	1	9	1	4		1	2	1							30
	4	1				3	2	6	2	8	3	2	3		1						31
	5			2		2	3	4	4	3	5	3	4		2						32
	6							1	2	2	1	1	2	1		1					11
	7							1													1
	8							1							1						2
Total		4	1	3	1	10	6	22	9	17	9	7	11	2	4	1					107
11	3	3		3		3		5	2	1	1			1							19
	4	1		1		3	1	10	1	2	4	3	1	1							28
	5			1		2	3	3	3	4	3	4	5	4	2						34
	6						2	1		1		5	2	1			2	2			16
	7									2		1		1			1				5
	8															1			1		2
Total		4		5		8	6	19	6	10	8	13	8	8	2	1	3	2	1		104
12	3	1	1	1		1	1	3	2												10
	4	1				1		9	4	3	6			1							25
	5					2	2	8	3	5	2	1	2	4	2						31
	6			1			1	1		3	6	5	4	4	1	1					27
	7								1		2	1	2	7	2	1					16
	8										1			2		1		3			7
Total		2	1	2		4	4	21	10	11	17	7	8	18	6	3		3			116
13	3			3		1		1			1										6
	4	1		1		1	1	2	2	1	2	2	2		1						16
	5	1					1	7	6	4	4	2	2								27
	6						1	3		2	5	6	1	2	2	1					23
	7							1		2		2		3		2	2				12
	8								1	1		1	2	1	4	5			1		16
Total		2		4		2	3	14	9	10	12	13	7	6	7	8	2		1		100
14	3					1		1			1										3
	4	2				1		1	1	5		1									11
	5			1				2	2	2	2	2	3	1	2	1					18
	6							1	2	1	3	1	3		3	1					15
	7	1								2	2		2	1	2	2	1				13
	8		1							2	2	1	2	1	6	5	2				22
Total		3	1	1		2		5	5	12	10	5	10	3	13	9	3				82
15	3						1		1												2
	4									1	1	1									3
	5						1			1											2
	6											1	1			1					3
	7											1	1	3		1					6
	8										1	4	1	2	3	2	3	1			17
Total							2		1	2	2	7	3	5	3	4	3	1			33
16	4								1												1
	5									2											2
	6																				
	7												2	3	3	1					9
	8					1					1	4	1	1	4		4				16
Total						1			1	2	1	4	3	4	7	1	4				28

conditions, in that they do not include all the children of the ages indicated. Take, for example, the group of 12-year-old children, the largest group presented. This shows 10 children in the third grade, 25 in the fourth, 31 in the fifth, 27 in the sixth, 16 in the seventh, and 7 in the eighth. Since the distribution of 12-year-old children throughout the grades is not rectilinear, as is shown by the part of the distribution given, it seems unlikely that if a full distribution were available it would stop at the lower end with 10 children in the third grade or at the upper end with 7 children in the eighth grade. It seems likely that there would be some 12-year-old children in grades below the third and in grades above the eighth. This opinion in the latter instance is substantiated by the fact that some 10- and 11-year-old children are in the eighth grade this year. If they progress normally, they will complete the work of the elementary school this year, and will not be enrolled in the school next year. The same thing is likely to have happened last year, so that there are now some children who are 12 years old and have completed the work that the school offered and are therefore not in school. Also, there are 13-, 14-, and even 15-year-old children in the third grade. There is every reason to suppose that there are 12-year-old children in grades lower than the third. In addition to the above considerations, it is known that there were some children absent from school on the day the tests were given.

As regards the second possibility mentioned for comparable groups: Is the selection by random sampling only? In so far as the selection is due to absence from school on the day the test was given, the selection may be considered random as to ability in the test concerned. The chief causes of absence mentioned by the teachers were work, bad weather, illness, and indifference on the part of the parents. The work for which the children were kept at home during the time these tests were being given (November and December) was usually working tobacco or killing hogs. While it is likely that more of the older children than of the younger ones were kept at home for work, still some of the younger ones were kept at home for this purpose. The discrepancy in absences between the older and younger children in regard to absence for work is reversed and probably neutralized by the discrepancy in absences due to bad weather and roads. The absences due to illness of the children and to indifference on the part of the parents may be assumed to be about the same for children of all ages.

On the other hand, the selection due to the inclusion of only those children in grade 3 to 8 inclusive is not random. The older children

in grades 1 and 2, that is, those who are not included in the distribution given, are in those grades because, in the opinions of the teachers, they are not so able as the children of the higher grades, or because they have for some reason become so retarded in their school work as to make them distinct from other children. In other words, these children are, in the opinions of the teachers, of less ability in school work than those of corresponding age who have been promoted to the higher grades. This means that the distributions given in Table I do not include the children who have the lower degrees of ability in school work. In the same way the younger children who have completed the eighth grade and are therefore not included in the table are, in the opinions of the teachers, the children having the higher degrees of ability in school work. All of which goes to show that the selection of cases for the age-groups as they are presented is not random.

The next consideration is whether the selection of age-groups, in such respects as it is not random, is due to the same causes acting equally and in the same direction, for all the schools to be measured, and in each of the age-groups. As is shown above, there is decided selection due to the failure to include children in grades 1 and 2, and those who have completed the eighth grade. This number of children is determined by the rate of progress of children through the grades. This rate of progress is unequal even for different schools within the same system, as has been shown repeatedly by studies widely separated both in time and locality. A good and recent example is furnished by the age-grade tables on page 90 of *An Educational Study of Alabama,* United States Bureau of Education Bulletin, 1919, No. 41.

The possibility still remains of correcting the tables presented. In order to correct an incomplete distribution such as that presented it is necessary to have a reasonably large part of the complete distribution. In the data presented the most nearly complete distributions are those for the ages 10, 11, 12 and 13. The distribution of 12-year-olds is the largest given, which indicates that it is most nearly complete. Taking this distribution as a sample, how may it be corrected?

Unfortunately the form of this distribution is not exactly that of the normal frequency curve. This is shown by that portion of the distribution which is given. It might also be inferred from the fact that in most school systems it is easier for a child to become retarded than it is for a child to make two grades in one year.[1] This natu-

[1] Strayer and Thorndike, *Educational Administration,* p. 38.

rally causes a skewed distribution. To correct a skewed distribution for truncation by the development of mathematical formulæ is a lengthy and complicated process, and one that is liable to serious error. Further, since the degree of skewedness and of truncation may both vary for every distribution to be studied, such correction is obviously too tedious and cumbersome a method to be used in a measure of school efficiency that is to be easily available for busy school men.

If an age-grade table of all the children in all the grades were available, it might serve as a basis for calculating the number of children in grades 1 and 2. It does not furnish a ready basis for finding the number who have completed the eighth grade. Also, for Madison County schools no such table is available.[1]

The problem resolves itself into an attempt to find the number of 12-year-old children who are in either the first or second grade, or who have completed the eighth grade. The 13-year-old children in the third grade this year probably were in the second grade last year when they were 12 years old. The probability is that last year the number of 12-year-old children in the second grade who were not promoted to the third grade was about equal to the number of 13-year-old children in the third grade who were not promoted to the fourth grade. Inasmuch as there has been no particular change in the school population of Madison County during the last few years, and in view of the above probabilities, the number of 13-year-old children in the third grade may be considered a fairly reliable indication of the number of 12-year-old children in the second grade.[2] Reference to Table I shows this number to be 6. Similarly, the 14-year-old children in the third grade may be considered a measure of the 12-year-olds in the first grade. This number is 3.

In much the same way it may be supposed that the number of 11-

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[1] To get a census showing the ages of children in the first and second grades of the Madison County public schools it would be necessary to visit each school, and in the case of children who do not know their age, to visit the home.

[2] In order to test the validity of this assumption a study was made of the age-grade tables for rural children and for children in places having a population of less than 2,000 given on page 90 of *An Educational Study of Alabama*, United States Bureau of Education Bulletin, 1919, No. 41, and the age-grade table for pupils in non-city schools given on page 309 of the *Survey and Report of the Virginia Public Schools Education Commission*. The actual number of 10-, 11-, 12- and 13-year-old children in grades 1 and 2 was compared with the number of such children estimated to be in these grades on the basis of the above assumption. The difference between the actual number of such children and the estimated number was reduced to a percentage basis showing the per cent of error in each estimate. Twenty-four estimates were made, and the median per cent of error, direction of error being taken into account, was —4½.

year-old children in the eighth grade this year is the same as the number of 11-year-old children in the eighth grade last year. These should be added to the 12-year-old distribution this year. Reference to Table I shows this number to be 2. In the same way the number of children who are 12 years old this year and who completed the eighth grade two years ago is estimated as 2.

Using these estimates, the following distribution of 12-year-old children is obtained: 3 in grade 1, Language Scale scores unknown; 116 in grades 3 to 8 inclusive, distributed according to Language Scale scores; 2 who completed grade 8 last year, Language Scale scores unknown; and 2 who completed grade 8 two years ago, Language Scale scores unknown.

Estimating corrections for the 10-, 11- and 13-year-old distributions on the same basis as for the 12-year-olds, gives Table II. In this table the figures in the columns under the captions X1, X2, X9, X10, and X11 are the estimated number of children of the respective ages in grades 1, 2, 9, 10 and 11 respectively.[1]

These corrections make the distributions for the ages 10, 11, 12 and 13 reasonably complete. There is still some elimination of children in the grades to be accounted for, and there is the possibility that some of the children of these ages may not have entered school. These considerations are probably not so serious, however, as the fact that the scores of the children represented by estimated additions to the distributions are unknown. It is known, however, that the children in the lower grades are likely to have made very low scores, while, on the contrary, the children who have completed the eighth grade would probably have made relatively high scores. Allowing these cases to remain undistributed at the respective ends of the distribution, the medians, Q's and P.E.'s of Table II are obtained.

The distributions of scores in this table show a great amount of overlapping for the different ages. Twenty per cent of the children in the 10-year-old group have scores superior to those of 50 per cent of the 13-year-old children. This overlapping is in accord with the results obtained with grade distributions.

[1] An attempt was made to estimate the necessary additions for these distributions on the basis of an age-grade table showing a form of distribution similar to that in Madison County. The age-grade table for the Alabama schools in places of less than 2,000 population was used. No estimate of children who had completed the eighth grade seemed feasible on this basis, and the medians calculated on the basis of the distributions corrected in this way showed coefficients of unreliability greater in every instance than those of the medians calculated on the basis of the above corrections.

As in the overlapping of grade distributions, so in this overlapping with age distributions, the unreliability of the individual measures gives an indication of greater overlapping than really exists.[1] In this case there is an added element tending to exaggerate the amount of overlapping in the undistributed scores at both ends of the age distributions. These scores tend to increase the inter-quartile range, and consequently the Q.

TABLE II

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF TRABUE LANGUAGE SCALE B SCORES IN THE 6-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																							Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	X9	X10	X11	
10	10	19	4	1	3	1	10	6	22	9	17	9	7	11	2	4	1	---	---	---	---	---	---	---	136
11	6	10	4	---	5	---	8	6	19	6	10	8	13	8	8	2	1	3	2	1	---	2	---	---	122
12	3	6	2	1	2	---	4	4	21	10	11	17	7	8	18	6	2	---	3	---	---	2	2	---	129
13	2	3	2	---	4	---	2	3	14	9	10	12	13	7	6	7	8	2	---	1	---	7	2	2	116

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	6.63	.37	9.00	2.00	3.50	M11—M10= .87	.311
11	7.50	.34	10.73	4.68	3.02	M12—M11=1.52	.283
12	9.02	.30	12.04	6.48	2.78	M13—M12= .73	.305
13	9.75	.35	13.00	6.92	3.03	M13—M10=3.12	.316

Another notable feature of this table is the great discrepancy between progress at different ages. The improvement the 11-year-old children show over the 10-year-olds is .87 of a step; that of the 12-year-olds over the 11-year-olds is 1.52; and that of the 13-year-olds over the 12-year-olds is .73 of a step. The progress in language ability as measured by this test is almost as great from ages 11 to 12 as the combined progress from ages 10 to 11 and from ages 12 to 13.

The total progress for the three-year period from 10 to 13 inclusive is 3.12 with a P.E. of .316.[2] Since these schools were in session for 6 months each year, the total school time for the three years is 18 months. This makes the average progress per month for the period .173 of a step.

The results of the Trabue Language Scale B test in the white schools of Madison County having a 9-month school term are handled in the

[1] Thorndike, E. L.: *Mental and Social Measurements*, p. 93. Kelley, T. L.: "The Measurement of Overlapping," *Journal of Educational Psychology*, X: 458*ff*. (December, 1919).

[2] Thorndike: *Mental and Social Measurements*, p. 194.

same way as are those from the schools having a 6-month school term. Table III gives the facts for these schools.

From this table it seems that the overlapping of language performance of children of different ages is about as great in the 9-month schools as in the 6-month schools. Some of the 10-year-old children have scores above the median score of the 13-year-olds. The same causes are operating to make this overlapping appear greater than it really is.

TABLE III

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF TRABUE LANGUAGE SCALE B SCORES IN THE 9-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																								Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	X9	X10	X11	
10	9	17	2	---	2	---	8	7	18	7	17	8	12	8	8	3	1	2	1	1	---	---	---	---	132
11	2	9	7	---	2	1	3	4	14	6	16	5	8	5	7	4	3	2	1	1	---	1	---	---	101
12	3	2	5	---	2	1	6	3	8	4	8	14	12	12	12	15	10	11	7	1	1	1	1	---	139
13	4	3	7	---	---	---	---	1	2	4	4	10	9	5	7	9	11	11	2	---	---	10	1	1	101

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	7.42	.32	10.33	4.37	2.98	M11—M10= .73	.290
11	8.15	.31	10.84	5.31	2.76	M12—M11=2.97	.284
12	11.12	.30	13.81	8.09	2.86	M13—M12=1.09	.295
13	12.21	.36	14.97	9.02	2.97	M13—M10=4.79	.304

NOTE.—In these and succeeding tables X1 is the estimated number in grade 1, scores unknown. X2, X9, X10 and X11 represent the corresponding facts for grades 2, 9, 10 and 11 respectively. M10 is the median for 10-year-old children, age last birthday at the time the test was given. M11, M12 and M13 are the medians for the ages 11, 12 and 13 respectively.

Also, the progress between the different ages is unequal, as in the case of the children in the 6-month schools. The improvement between ages 10 and 11 is .73 of a step; between ages 11 and 12 it is 2.97 steps; and between ages 12 and 13 it is 1.09 steps. The total improvement for the three-year period from ages 10 to 13 inclusive is 4.79 steps, with a P.E. of .304. Since there are 9 months of school each year, the total school time represented is 27 months. The average monthly improvement, therefore, is .177 of a step. The corresponding improvement for the 6-month schools is .173 of a step.

This comparison would be valid and significant if it could be assumed that the quality measured, ability to complete correctly sentences in which certain words are missing, was improved only by school

work. Such, however, is not known to be the case. It is entirely possible that this quality improves by a natural development as the age and experience of the subject increases. It is possible, and even probable, that this ability to complete sentences is improved both by natural development and by school work. The conclusion from the above comparison, therefore, is that schooling and natural development accomplish an improvement of this ability of 4.79 steps between the ages of 10 and 13 inclusive for the children in places in Madison County having a 9-month school term, and of 3.12 steps in places in the same county having a 6-month school term.

TABLE IV

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF TRABUE LANGUAGE SCALE B SCORES IN CERTAIN WHITE SCHOOLS OF LOUISVILLE, KY.

Age	Scores																								Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	X9	
10	4	12	36	..	..	..	..	1	..	8	2	18	4	32	17	43	17	29	6	14	1	3	..	..	..	247
11	1	4	12	2	..	..	..	4	2	5	1	13	6	39	9	55	11	67	13	26	1	17	..	6	..	292
12	..	1	4	..	..	..	..	2	1	2	3	21	3	19	12	43	19	77	16	70	4	27	4	4	..	332
13	..	..	1	..	..	..	..	2	..	3	1	10	5	22	8	53	13	65	27	46	6	20	1	7	26	316

	Median	P. E. true —obtained mediad	75 per-centile	25 per-centile	Q		P. E.
10	11.32	.24	13.48	7.37	3.11	M11—M10=1.58	.174
11	12.90	.14	14.37	10.36	2.00	M12—M11=1.56	.120
12	14.46	.13	16.37	12.34	2.01	M13—M12= .15	.120
13	14.61	.14	16.58	12.50	2.04	M13—M10=3.29	.174

Table IV gives the facts in regard to the Trabue Language Scale B test for certain of the white schools of Louisville. The papers on which this table is based were given, collected and scored by the Psychological Laboratory of the Louisville Board of Education.

The total improvement in ability to complete sentences in these schools for the three-year period from ages 10 to 13 inclusive is 3.29. The P.E. of this gain is .174, a little over 5 per cent of the gain. The probable deviation of the true measure of this gain from the measure obtained is only about half as great as in the Madison County schools, either those having a 9-month school term or those having a 6-month term. The total gain made is a little greater than in the case of the Madison County 6-month schools and is not quite so great as in the case of the Madison County 9-month schools. The median ability of the respective age-groups, on the other hand, is materially higher than

is the case in any of the Madison County schools. The median for the Louisville 10-year-old children is higher than for any of the age-groups of the 6-month schools, and is higher than all except the 13-year-old group for the 9-month schools. The median ability of the Louisville 13-year-old group is 14.61; that for the Madison County 9-month schools of corresponding age is 12.21, and for the 6-month schools is 9.75. The 13-year-old children in Louisville have an ability to complete sentences that is 50 per cent greater than the like ability of children of the same age in the 6-month schools of Madison County.

The progress made each year in the Louisville schools is unequal, as is the case in the Madison County schools. In Louisville the progress from 10 to 11 is 1.58; from 11 to 12 it is 1.56; and from 12 to 13 it is .15.

TABLE V

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF TRABUE LANGUAGE SCALE B SCORES IN PATERSON, N. J.

Age	Scores																						Total
	X1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	X9	X10	
10	....	5	2	7	2	5	4	23	18	31	20	34	23	15	13	4	2	1	....	....	....	....	....	209
11	....	....	....	1	....	6	4	11	10	17	16	34	27	29	18	11	4	7	2	2	1	....	....	200
12	....	1	....	....	3	5	2	8	8	15	16	39	19	32	25	18	9	9	3	3	1	8	....	224
13	....	....	....	2	1	1	2	6	2	14	13	25	20	29	26	17	16	12	9	1	....	42	8	246

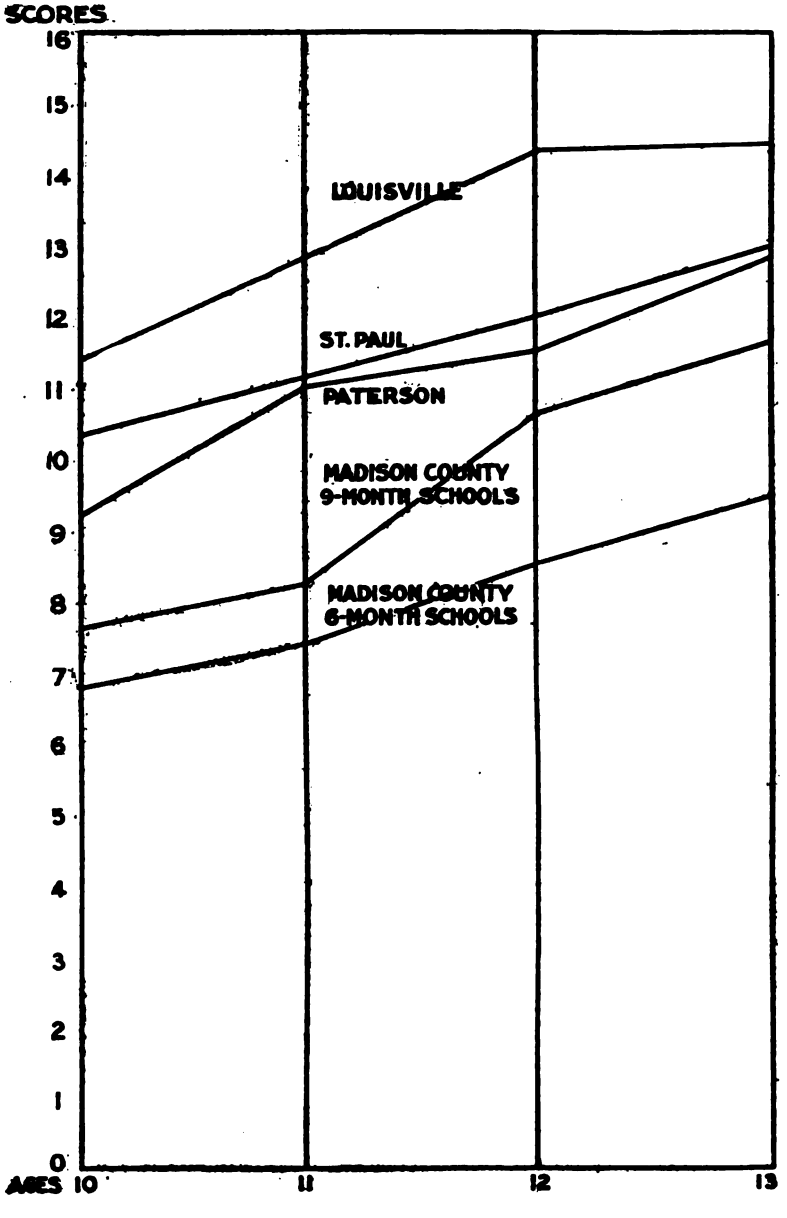
	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	9.03	.12	10.01	7.02	1.49	M11—M10=2.27	.128
11	11.30	.16	12.82	9.06	1.88	M12—M11= .48	.141
12	11.78	.16	13.80	9.87	1.96	M13—M12=1.52	.180
13	13.30	.24	16.87	10.82	3.02	M13—M10=4.27	.170

Table V gives the facts in regard to the Trabue Language Scale B for schools in Paterson, New Jersey. The data from which this table is compiled were collected by the department of school administration of Teachers College, Columbia University.

The total gain in ability to complete sentences in the Paterson schools is 4.27. This gain is greater than in the case of any other schools presented in this study. The P.E. of this gain is .170, which is about the same as that for the like measure in Louisville. Since the gain in this case is greater, the proportion of the probable error to the gain is a little less; in Paterson 4 per cent as against a little more than 5 per cent in Louisville. The median ability of the 13-year-old children in the Paterson schools is 13.30 as against 14.61 in the Louisville schools.

CHART I

PROGRESS IN TRABUE LANGUAGE COMPLETION TEST SCORES BETWEEN AGE GROUPS IN THE PUBLIC SCHOOLS OF MADISON COUNTY, KY.; LOUISVILLE, KY.; PATERSON, N. J.; AND ST. PAUL, MINN.



This median ability of the 13-year-old children in Paterson, however, is greater than is the like measure for the 6-month or the 9-month schools of Madison County.

The yearly gains are again unequal. From 10 to 11 the gain is 2.27; from 11 to 12 it is .48; and from 12 to 13 it is 1.52.

Table VI gives the facts in regard to the Trabue Language Scale B in St. Paul, Minnesota. This table is based upon data printed in the *St. Paul Survey*.

TABLE VI

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF TRABUE LANGUAGE SCALE B SCORES IN ST. PAUL, MINN. BASED ON TABLES PUBLISHED IN THE ST. PAUL SURVEY

Age	Scores																					Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	X9	
10	4	---	15	4	19	9	30	24	56	33	63	41	52	26	24	12	4	1	---	---	---	417
11	1	---	2	1	8	6	24	8	39	25	53	30	53	35	50	8	11	3	---	2	---	359
12	---	---	1	1	3	4	13	13	42	21	55	39	77	45	50	30	20	4	4	---	---	422
13	---	---	2	1	5	1	10	11	21	16	41	39	61	54	66	40	29	14	7	1	38	453

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	10.32	.13	12.28	7.96	2.25	M11—M10=1.18	.120
11	11.41	.14	13.55	9.03	2.26	M12—M11= .83	.106
12	12.24	.11	14.05	10.13	1.96	M13—M12=1.10	.098
13	13.34	.12	15.29	11.13	2.08	M13—M10=3.11	.106

The total gain in ability to complete sentences in this case is 3.11. This gain is less than in any of the other systems studied. The median ability of the 13-year-old children, on the other hand, is 13.34, which is higher than the like ability of the same age-group in any of the other systems studied except Louisville. The P.E. of the gain in these schools is .106, which is less than 4 per cent of the gain made. The reliability of the measure in St. Paul seems a little greater than in any of the other systems considered. The progress from age to age is unequal. From ages 10 to 11 it is 1.18; from ages 11 to 12 it is .83; and from ages 12 to 13 it is 1.10.

Chart I shows the progress for the different systems both relatively and absolutely. It is significant that while the progress in the Madison County schools having a 9-month school term is relatively a little greater than the progress in the city schools presented, the total result is less. In other words, although the children gain as much or a little more in ability to complete sentences between the ages of 10 and 13, they have less of this ability when they began and less when they get

through. This would seem to indicate either later entrance in school or poorer work with the lower grades, possibly both.

The following table summarizes the total gain in ability to complete sentences, as measured by the Trabue Language Scale B, between the ages of 10 and 13, for the respective school systems considered. It also shows the P.E. of this total gain, and the number of cases on which this measure of gain is based.

School Systems	Total gain	P.E. of total gain	Total frequencies
	10 to 13		10 and 13
Madison County, 6-month schools	3.12	.316	252
Madison County, 9-month schools	4.79	.304	233
Louisville	3.29	.174	563
Paterson	4.27	.170	455
St. Paul	3.11	.106	870

It should be noted that the reliability of the gains given, as indicated by a relatively small P.E., is much greater in the city schools than in the Madison County schools. This is due in part to the greater number of cases. That it is not wholly due to this cause is indicated by the fact that the reliability is greater for the Madison County 9-month schools than for the 6-month schools, though the number of cases is slightly less. It is possible that this greater reliability is due in part to a more uniform type of work in the city and town school systems than in the country schools.

It is also to be noted that the combination of elimination, natural development and schooling over a three-year period increased the ability to complete sentences 4.79 steps in places in Madison County having a 9-month school term, 4.27 steps in Paterson, 3.29 steps in Louisville, 3.12 steps in places in Madison County having a 6-month school term, and 3.11 steps in St. Paul. If it may be assumed that the amount of this increase due to natural development is the same in all these places, the efficiency of the schools in training and eliminating children between the ages of 10 and 13 in such ability in language as is measured by the Trabue Language Scales would rank in the above order.

This ranking does not agree with that obtained by ranking in order of the median ability of the 13-year-old children. Ranking in this way, Louisville comes first with a median of 14.61, St. Paul second with 13.34, Paterson third with 13.30, Madison County 9-month schools fourth with 12.21, and Madison County 6-month schools last with 9.75.

This discrepancy may be due to a difference in the work with children under 10, to a greater irregularity of attendance of the younger children in some systems than in others, to a difference in the amount of gain due to natural development because of different environment, to a difference in care in scoring papers, to a difference in intellectual level of the communities, or to a combination of these causes.

The following table shows the yearly gains in each of the systems of schools studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Madison County, 6-month schools	.87	1.52	.73
Madison County, 9-month schools	.73	2.97	1.09
Louisville	1.58	1.56	.15
Paterson	2.27	.48	1.52
St. Paul	1.18	.83	1.10
Total	6.63	7.36	4.59

This table seems to indicate that the greatest gain is made from ages 11 to 12, but that material gain may be made during any of the yearly periods from ages 10 to 13 inclusive.

CONCLUSIONS

1. The difference in performance as measured by the Trabue Language Scale B of school children of different ages can be obtained.

2. Since this test measures a quality not proved to be solely, or even largely, determined by school training, this difference is not a reliable measure of school efficiency.

3. This difference does measure the improvement of children in the respective systems as to the function measured, such improvement being due to school training and other influences.

4. The children in the Madison County 6-month schools show less improvement during the three-year period from 10 to 13 inclusive than do the children in any of the other systems except St. Paul.

5. The 13-year-old children in the Madison County 6-month schools show less ability in the function measured than do the children of like age in any of the other systems studied.

6. The children in the Madison County 9-month schools show reasonable improvement during the three-year period from 10 to 13 in-

clusive, but the ability of the 13-year-old children to complete sentences is less than the like ability of 13-year-old children in any of the systems studied except the 6-month schools in the same county.

CHAPTER IV

ACHIEVEMENT AS MEASURED BY THE COURTIS STANDARD RESEARCH TESTS IN ARITHMETIC SERIES B

At the same time that the Trabue Language Scale B was given in the schools of Madison County, the Courtis Standard Research Test in Arithmetic Series B was used.

The problems involved in finding the difference in performance of different age-groups are practically the same as in the work with the Trabue Language Scale B. Distributions for the respective age-groups are completed on the same assumptions, and the same age-groups are used throughout. The number of examples correctly completed has been used as the score.

The work in addition, subtraction, multiplication and division is presented in sections 1, 2, 3 and 4 respectively of this chapter.

Section 1. Addition

Table VII gives the data in addition for the children 10 to 13 years of age inclusive in the Madison County schools having a 6-month term.

A new problem is presented in this table in that the medians of the

TABLE VII

Age Distribution, 10 to 13 Inclusive, of Courtis Series B Arithmetic Tests Addition Rights in the 6-Month White Schools of Madison County, Ky.

Age	Scores															Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	X9	X10	X11	
10	11	19	65	25	9	7	6	------	1	1	------	------	------	------	------	144
11	5	11	54	20	12	10	6	4	2	------	------	------	2	------	------	126
12	3	5	62	19	19	5	7	8	4	2	------	------	4	2	------	140
13	2	3	45	16	13	8	11	5	------	------	------	1	13	4	2	123

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.64	.07	1.52	.09	.71	M11—M10= .23	.072
11	.87	.11	2.37	.28	1.04	M12—M11= .13	.092
12	1.00	.12	2.48	.43	1.20	M13—M12= .71	.147
13	1.71	.21	4.47	.57	1.90	M13—M10=1.07	.136

10- and 11-year-old groups fall in the 0 to 1 interval, and that the 25 percentiles of all age-groups fall in the same interval. It may be

questioned whether the children in grades 1 and 2, grouped under the captions X1 and X2, should be considered as having a score of 0, or whether an attempt should be made to distribute their scores. Tabulation of the pupils' test papers shows that there are 147 children in grade 3, and that 127 of these grade 3 children made a score of 0. Since 127 out of 147 children made a score of 0 and since it may be safely assumed that children in grades 1 and 2 would not do so well as children in grade 3, the score of these first and second grade children has been considered as 0. Scores given under the caption 0 have been considered as distributed evenly between 0 and 1.

The large number of scores in the 0 to 1 interval as well as the scores considered as 0 indicate that the ability in addition required to do any of the examples in the Courtis Standard Research Tests in Arithmetic Series B is so great as to preclude measurement of many of the individuals tested further than to show that their ability is less than the lowest ability measured by this test. The great number of 0 cases also reduces Q.

TABLE VIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN THE 9-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	X9	X10	X11	
10	9	16	23	14	19	11	16	6	5	5	1	----	1	1	----	----	----	127
11	1	9	21	13	12	7	10	7	9	2	2	----	----	3	1	----	----	94
12	3	1	21	19	15	24	17	6	13	6	2	1	----	1	1	1	----	131
13	4	3	7	15	11	11	17	8	5	3	2	1	----	1	8	1	1	98

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	2.07	.21	4.20	.26	1.97	M11—M10= .18	.206
11	2.25	.26	4.75	.64	2.05	M12—M11=1.02	.194
12	3.27	.19	4.89	1.40	1.74	M13—M12= .54	.186
13	3.81	.25	5.68	1.70	1.99	M13—M10=1.74	.198

The total gain in ability to add for the three-year period from ages 10 to 13, as measured by the difference in the median scores of the 10-year-old and the 13-year-old children who took the test, is 1.07, with a P.E. of .136. This P.E. is slightly over 12 per cent of the total gain indicated.

The improvement in ability to add from year to year, as measured by the difference between the median scores of the respective age-groups, is uneven, as it is in the case of language. From ages 10 to 11 the improvement is .23; from ages 11 to 12 it is .13; and from ages

12 to 13 it is .71. The improvement from ages 12 to 13 is practically twice as great as the combined improvement from ages 10 to 11 and from ages 11 to 12. Apparently the first real teaching of such ability to add as is measured by the Courtis Standard Research Tests in Arithmetic Series B in these schools is to children between the ages of 12 and 13.

Table VIII presents the facts in regard to addition in the 9-month schools of Madison County. The same statistical method is used as that used with the data from the 6-month schools.

The total improvement in ability to add in these schools for the three-year period from ages 10 to 13 inclusive is 1.74. The P.E. of this improvement is .198, or slightly under 12 per cent of the total gain. The accuracy of the measurement for the 6-month schools is indicated by a P.E. showing slightly over 12 per cent of the total gain; just about the same degree of reliability.

The improvement by years varies for these schools as it does for

TABLE IX

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN LOUISVILLE, KY. (WHITE SCHOOLS)

Age	Scores																										Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	X9	
10	8	16	43	12	16	19	38	33	27	28	14	18	10	5	6	1	1		1	---	1	---	---	---	---	---	---	---	289
11	5	8	16	10	11	21	28	31	35	29	28	27	21	10	10	4	2	3	---	3	1		---	1		---	---	---	304
12	---	5	8	6	10	22	23	25	34	26	28	37	28	13	13	6	9	4	2	2	1	---	---	---	---	1	1	---	304
13	---	---	5	8	9	19	18	25	29	26	30	24	25	18	13	13	9	1	4	2	1	---	1	---	---	---	1	25	306

	Median	P. E. true —obtained	75 per-centile	25 per-centile	Q		P.E.
10	3.77	.21	6.26	.43	2.91	M11—M10=1.85	.170
11	5.62	.18	8.22	3.17	2.52	M12—M11=1.11	.155
12	6.73	.18	9.14	4.08	2.53	M13—M12= .73	.202
13	7.46	.27	12.80	5.08	3.86	M13—M10=3.69	.213

the 6-month schools. From ages 10 to 11 it is .18; from ages 11 to 12 it is 1.02; and from ages 12 to 13 it is .54. The greatest gain occurs between the ages of 11 and 12. This occurs a year earlier than the greatest gain in the case of the 6-month schools.

The median achievement for children of each age is materially higher than is the case in the 6-month schools. For the 13-year-old children this median achievement is 3.81 in the 9-month schools as against 1.71 in the 6-month schools; a difference of 2.10 in favor of the schools having the longer term.

For the purposes of comparison, data are presented in Tables IX to XIII inclusive from certain other school systems.

Table IX, for Louisville, Kentucky, is based on data in the Psychological Laboratory of the Louisville Board of Education, and is for certain of the white schools of the city. The tests were given under the direction of the Psychological Laboratory during the school year prior to June, 1918.

Table X, for Louisiana, is based on tests given by the parish supervisors in thirteen Louisiana parishes. The schools tested were white schools selected by the supervisors as neither the best nor the worst in their respective parishes. They range in size from one teacher to

TABLE X

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN CERTAIN WHITE SCHOOLS IN LOUISIANA

Age	Scores																					Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	X9	X10	X11	
10	24	43	58	48	31	24	23	12	10	6	4	1	1		1								287
11	13	24	43	47	38	27	28	20	16	10	8	2	1	1	1					1			280
12	7	13	24	45	37	51	41	30	18	11	11	6		1	1				1	1	1		299
13		7	13	50	35	42	31	28	16	16	8	6	5	1						17	1	1	277

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.38	.09	2.46	0.00	1.23	M11—M10= .96	.094
11	1.34	.13	3.64	0.00	1.83	M12—M11=1.12	.106
12	2.46	.12	4.20	.68	1.76	M13—M12= .33	.114
13	2.79	.15	5.10	.98	2.06	M13—M10=2.41	.102

TABLE XI

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN ARKANSAS CITY

Age	Scores															Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	X9	
10	15	54	65	54	46	19	29	14	8	6	2					312
11	8	15	54	49	33	35	17	29	10	4	3	2				259
12	3	8	15	63	54	37	33	34	22	8	6	8		3		294
13	1	3	8	34	32	36	39	37	32	12	4	6	4	5	1	254

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.40	.03	1.00	0.00	.50	M11—M10= .70	.072
11	1.10	.11	3.01	0.00	1.50	M12—M11=1.00	.098
12	2.10	.12	4.22	.75	1.73	M13—M12=1.23	.106
13	3.33	.13	5.01	1.64	1.68	M13—M10=2.93	.082

sixteen teachers. In some cases only a limited number of the pupils were tested in each grade. When this was done, the teacher was asked

to select pupils neither the brightest nor the dullest. This manifestly gives a selection that is not accurately representative of the Louisiana schools; it seems likely that the selection tends to be above rather than below the median situation, and the range is less in proportion as the teachers and supervisors have succeeded in avoiding the extreme cases.

Tables XI and XII, for Arkansas City and for Salina, are based on tabulations made from papers collected by the Bureau of Educational Measurements and Standards of the State Normal School at Emporia,

TABLE XII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN SALINA, KAN.

Age	Scores																										Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	X9	X10	
10	16	20	43	46	43	44	44	26	20	15	14	..	3	1	..	..	---	---	---	---	---	---	---	---	---	---	---	335
11	4	16	20	15	49	42	36	36	37	11	8	12	8	..	..	1	---	---	---	---	---	---	---	---	2	---	---	296
12	2	4	16	14	24	38	48	57	43	29	6	8	6	9	1	4	---	---	---	---	---	---	---	---	---	2	---	311
13	---	2	4	13	13	30	27	40	32	40	16	17	11	10	5	4	1	---	---	---	---	---	2	---	---	5	2	274

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	1.98	.12	3.89	.10	1.89	M11—M10=1.08	.120
11	3.06	.13	5.10	1.34	1.34	M12—M11=1.10	.114
12	4.16	.12	5.70	2.46	1.62	M13—M12=1.09	.114
13	5.25	.15	7.25	3.24	2.00	M13—M10=3.27	.120

TABLE XIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS ADDITION RIGHTS IN HIBBING, MINN.

Age	Scores																										Total
	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X9	X10	
10	16	34	34	27	31	32	24	19	12	12	7	3	2	1	1	1	---	1	---	---	---	---	---	---	---	---	---	257
11	---	16	23	30	20	32	25	20	12	17	12	9	9	8	3	4	3	1	---	---	---	---	---	---	---	---	---	244
12	---	---	11	16	25	16	14	19	24	17	19	16	13	4	7	3	3	5	2	---	2	---	---	---	2	4	---	222
13	---	---	3	4	8	15	10	13	9	16	18	11	11	10	2	1	3	2	---	2	2	1	1	---	---	33	4	179

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	2.56	.16	4.78	.41	2.18	M11—M10=1.44	.164
11	4.00	.21	7.22	1.73	2.74	M12—M11=2.41	.206
12	6.41	.25	9.34	3.21	3.06	M13—M12=2.22	.322
13	8.63	.45	15.12	5.36	4.88	M13—M10=6.07	.297

Kansas. The tests were given and scored by the teachers during the two years prior to June, 1917.

Table XIII, for Hibbing, Minnesota, is based on papers collected by the Department of Research of the Hibbing schools. The tests were given by the teachers and scored by clerks in the fall of 1919.

In the following summary the total improvement in ability to add for the three-year period from ages 10 to 13 inclusive is given for each system of schools reported, and also the median ability of each 13-year-old group. This median for the 13-year-old group may be considered in a way as a measure of the result obtained in any system with children up to the age of 13.

School Systems	Total gain	Medians
	10 to 13 inclusive	13-year-old children
Hibbing	6.07	8.63
Louisville	3.69	7.46
Salina	3.27	5.25
Arkansas City	2.93	3.33
Louisiana	2.41	2.79
Madison County, 9-month schools	1.74	3.81
Madison County, 6-month schools	1.07	1.71

It is significant that the ranking in order of median ability of 13-year-old children so nearly coincides with ranking in order of total improvement for the three-year period from 10 to 13 inclusive. The only difference is that the order of Louisiana schools and the Madison County 9-month schools is inverted in the two rankings. The ability to add is a mechanical ability, taught definitely in the schools, and very little affected by the process of natural development which was so potent a factor in the case of language ability as measured by the Trabue Language Scale.

Differences in method of giving the tests and in detail of procedure in different places affect the medians of the 13-year-old groups of children. These elements of error may be of determining size in cases where the tests are given by interested parties, such as teachers. When the difference between medians for groups of children of different ages is taken as a measure, the sources of error referred to above neutralize each other, since it may be assumed that the errors will be as great for one group of children as for another group, the tests being given at the same time in the same system and with the same

general directions or lack of directions. The ranking in order of the total gain in ability to add over the three-year period from ages 10 to 13 inclusive is therefore the more significant ranking.

The following summary shows the yearly gain in each of the systems of schools studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Hibbing	1.44	2.41	2.22
Louisville	1.85	1.11	.73
Salina	1.08	1.10	1.19
Arkansas City	.70	1.00	1.23
Louisiana	.96	1.12	.33
Madison County, 9-month schools	.18	1.02	.54
Madison County, 6-month schools	.23	.13	.71
Total	6.44	7.89	6.95

The extreme variation in the amount of yearly gain is significant in that it shows so great a lack of uniformity in the time of teaching so fundamental a process as that of column addition. The totals indicate that as a rule greater progress is made in teaching this process between the ages of 11 and 12; that the period from ages 12 to 13 is next; and that the least gain is made from ages 10 to 11.

CONCLUSIONS

1. Such difference in performance in addition as is measured by the Courtis Standard Research Tests can be obtained for school children of different ages.

2. Since this test measures an ability trained in the schools and not greatly dependent on natural development, this difference in performance is a valid measure of school efficiency in teaching this process.

3. Material gain in ability to add may be made with children during any of the age periods, 10 to 11, 11 to 12, or 12 to 13.

4. The difference in ability of children of different age-groups is a valid measure, even though there may have been some irregularity in the giving of the tests.

5. That all the school systems investigated are doing better work in the teaching of addition than are the schools of Madison County.

6. That the schools in Madison County having a 6-month school term are doing poorer work than the schools having a 9-month term. That is to say, the one- and two-teacher schools are doing poorer work than the larger schools.

Section 2. Subtraction

The data presented in subtraction are tabulated from the same sets of papers used for addition. The subtraction tests were given under the same conditions as those in addition, by the same people, and were corrected and collected in the same way. The statistical procedure has been the same in tabulating and calculating.

Table XIV gives the facts in regard to subtraction in the Madison County 6-month schools.

TABLE XIV

Age Distribution, 10 to 13 Inclusive, of Courtis Series B Arithmetic Tests Subtraction Rights in the 6-Month White Schools of Madison County, Ky.

Age	Scores																		Tota
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	X9	X10	X11	
10	10	19	76	13	7	5	8	2	1	----	----	----	----	----	----	----	----	----	141
11	6	10	69	11	6	6	8	3	----	3	----	----	----	----	1	2	----	----	125
12	3	6	61	13	13	10	8	7	3	4	2	1	----	----	----	4	2	----	137
13	2	3	48	12	11	8	8	5	4	2	----	2	----	1	----	11	4	2	123

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.54	.05	1.05	.08	.48	M11—M10= .13	.058
11	.67	.08	1.79	.22	.78	M12—M11= .30	.111
12	.97	.17	3.67	.41	1.63	M13—M12= .73	.188
13	1.70	.25	5.05	.53	2.26	M13—M10=1.16	.162

In these schools the median ability in subtraction for children 10, 11 and 12 years of age is between 0 and 1, and the 25 percentile for each of the age-groups presented falls within the same interval. Apparently most of the children in these schools under 14 years of age possess an ability in subtraction that is so slight that it cannot be measured by this test.

The total gain in ability to subtract for the three-year period from ages 10 to 13 inclusive, as measured by the difference between the median scores of the 10-year-old children and the 13-year-old children, is 1.16. The P.E. of this measure of gain from the true measure is .162, almost 14 per cent of the total gain. The probable actual deviation from the difference obtained is reasonably small, but the very small difference

obtained makes this probable deviation quite large proportionately. The same thing is true in the case of addition.

The improvement from year to year increases consistently. From ages 10 to 11 it is .13; from ages 11 to 12 it is .20; and from ages 12 to 13 it is .73.

Table XV gives the facts in regard to subtraction in the Madison County 9-month schools.

The median ability in subtraction of each of the age-groups is above 1. The 25 percentiles of the 10- and 11-year-old groups fall in the 0 to 1 interval.

TABLE XV

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN THE 9-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																			Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X9	X10	X11	
10	9	17	38	12	6	6	17	11	7	5	3	1	---	2	---	---	---	---	---	---	124
11	2	9	26	12	5	6	6	9	5	6	6	1	4	---	---	---	---	1	---	---	98
12	3	2	25	8	6	16	10	13	14	10	7	9	3	---	1	---	1	1	1	---	130
13	4	3	3	8	13	11	7	9	9	6	10	4	4	1	---	1	---	8	1	1	103

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	1.66	.26	4.88	.17	2.35	M11—M10= .34	.270
11	2.00	.33	5.83	.51	2.66	M12—M11=2.50	.280
12	4.50	.31	7.05	1.31	2.87	M13—M12= .77	.289
13	5.27	.35	8.42	2.59	2.91	M13—M10=3.61	.279

The total gain for the three-year period from ages 10 to 13 inclusive is 3.61, as against a gain for a similar period of years in the 6-month schools of 1.16. The P.E. of the gain in the 9-month schools (3.61) is .279; a little less than 8 per cent of the total gain. The probable actual deviation of the true from the obtained difference in the case of the 9-month schools is greater than in the case of the 6-month schools, .279 as against .162, but in proportion to the respective gains it is less.

The progress from year to year is uneven. From ages 10 to 11 it is .34; from ages 11 to 12 it is 2.50; and from ages 12 to 13 it is .77. By far the largest gain occurs between the ages 11 and 12.

Tables XVI to XX inclusive present comparative data from other school systems, as was done for addition. In the following summary the total improvement in ability to subtract for the three-year period from ages 10 to 13 inclusive is given for each of the systems of schools

TABLE XVI

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN CERTAIN WHITE SCHOOLS OF LOUISVILLE, KY.

Age	Scores																										Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	X9	
10	10	18	45	5	15	22	29	34	27	27	14	18	11	4	4	2	1	..	1	1	..	..	..	..	..	..	..	..	..	286
11	5	10	18	9	11	12	18	22	27	32	27	34	31	21	10	12	3	5	1	1	1	1	..	1	..	1	..	..	..	313
12	..	5	10	2	6	15	12	20	28	31	37	34	23	26	19	11	11	10	9	3	2	5	2	2	..	1	..	..	..	324
13	..	..	5	3	1	1	2	15	26	20	36	29	31	21	30	16	11	13	5	7	2	3	2	2	2	..	..	1	26	310

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	4.02	.23	6.42	.10	3.16	M11—M10=2.74	.184
11	6.76	.19	9.31	3.73	2.79	M12—M11=1.13	.162
12	7.89	.18	10.76	5.39	2.68	M13—M12=1.65	.162
13	9.54	.20	12.78	7.12	2.83	M13—M10=5.52	.184

TABLE XVII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN CERTAIN SCHOOLS IN LOUISIANA

Age	Scores																					Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	X9	X10	X11	
10	24	46	52	52	21	38	13	15	10	10	1	3	1	..	..	..	..	..	..	..	..	..	297
11	14	24	46	46	35	30	22	21	19	12	6	4	5	1	1	2	..	..	..	1	..	..	289
12	7	14	24	42	23	28	36	35	29	20	8	11	9	8	6	..	..	1	1	1	1	..	304
13	..	7	14	36	18	29	29	34	21	25	13	12	12	5	3	1	..	..	..	16	1	1	277

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.31	.13	3.75	0.00	1.87	M11—M10=1.10	.120
11	1.41	.14	3.98	0.00	1.99	M12—M11=1.97	.134
12	3.38	.17	5.65	.73	2.41	M13—M12= .78	.156
13	4.16	.19	6.79	1.68	2.55	M13—M12=3.85	.144

TABLE XVIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN ARKANSAS CITY

Age	Scores																		Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X9	
10	18	52	60	37	31	25	25	23	16	7	8	..	1	..	2	..	..	..	..	305
11	8	18	52	33	31	22	24	16	18	7	17	3	1	2	5	..	..	..	..	257
12	4	8	18	29	22	31	26	45	25	25	19	16	7	2	3	2	..	1	..	283
13	1	4	8	21	10	18	25	31	20	37	26	25	11	7	3	4	2	..	1	254

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.60	.11	3.23	0.00	1.61	M11—M10= .96	.122
11	1.56	.16	4.29	0.00	2.14	M12—M11=2.51	.141
12	4.07	.17	6.17	1.53	2.32	M13—M12=1.38	.148
13	5.45	.17	7.59	3.06	2.26	M13—M10=4.85	.130

TABLE XIX

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN SALINA, KAN.

Age	Scores																										Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X9	X10	
10	15	19	46	17	21	33	30	41	35	31	23	20	6	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	341
11	4	15	19	11	19	13	14	40	32	36	23	30	18	8	7	4	2	..	..	..	..	..	..	..	..	..	..	..	295
12	3	4	15	3	5	10	27	36	27	45	28	33	27	19	11	8	3	..	3	1	1	..	..	..	..	..	2	..	309
13	....	3	4	5	3	4	8	17	31	45	37	28	20	24	13	6	7	1	3	1	..	..	..	..	2	1	1	2	266

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	3.65	.19	5.96	.30	2.83	M11—M10=1.74	.162
11	5.39	.19	7.79	2.44	2.62	M12—M11=1.15	.148
12	6.54	.16	8.87	4.28	2.29	M13—M12= .81	.134
13	7.35	.15	9.72	5.72	2.00	M13—M10=3.70	.150

TABLE XX

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS SUBTRACTION RIGHTS IN HIBBING, MINN.

Age	Scores																										Total
	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X9	X1	
10	16	35	33	9	10	12	14	22	20	16	16	15	4	9	6	5	3	..	3	..	..	..	..	..	..	..	..	248
11	....	16	20	6	11	9	25	15	20	16	22	18	19	12	6	7	4	2	4	2	1	2	1	..	..	..	..	238
12	....	....	3	6	6	13	11	12	22	19	18	18	19	25	11	7	13	6	7	2	3	..	..	1	1	4	..	227
13	....	....	2	2	4	4	10	9	3	9	16	13	10	19	15	5	7	6	1	4	2	..	..	1	..	32	4	179

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	4.64	.30	7.93	.33	3.80	M11—M10=2.16	.240
11	6.80	.25	10.02	3.72	3.15	M12—M11=2.39	.212
12	9.19	.23	11.93	6.26	2.83	M13—M12=2.15	.260
13	11.34	.36	15.87	8.10	3.88	M13—M10=6.70	.284

reported, and also the median ability of each 13-year-old group. As in addition, so in subtraction, this median for the 13-year-old group may be considered in a way as a measure of the result obtained in any system with children up to the age of 13.

SCHOOL SYSTEMS	TOTAL GAIN	MEDIANS
	10 to 13 inclusive	13-year-old children
Hibbing	6.70	11.34
Louisville	5.52	9.54
Arkansas City	4.85	5.45
Louisiana	3.85	4.16
Salina	3.70	7.35
Madison County, 9-month schools	3.61	5.27
Madison County, 6-month schools	1.16	1.70

The ranking in order of total gain made for the three-year period from ages 10 to 13 inclusive corresponds quite well with the ranking in order of medians for the 13-year-old children. This correspondence is not so close as was the case with addition; there are four displacements in the ranking. As was the case with addition, the ranking in order of total gain for the three-year period is the more significant, since the use of a difference as a measure tends to neutralize errors in the giving and scoring of the test.

It is interesting to note that the rank in gain in ability to subtract is not the same as that in ability to add. Arkansas City and Louisiana both come ahead of Salina in subtraction, and not in addition. This difference between the rank of these systems for the two processes would seem to indicate that subtraction needs to be taught; that improvement in addition does not necessarily carry with it exactly proportionate ability to subtract.

The following summary shows the gain for each yearly age-period in the systems studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Hibbing	2.21	2.34	2.15
Louisville	2.74	1.13	1.65
Arkansas City	.96	2.51	1.38
Louisiana	1.10	1.97	.78
Salina	1.74	1.15	.81
Madison County, 9-month schools	.34	2.50	.77
Madison County, 6-month schools	.13	.30	.73
Total	9.22	11.90	8.27

The variations are as great in the amount of yearly gain as they were shown to be in addition. As in addition, so in subtraction, the greatest yearly gain seems to be between the ages of 11 and 12. In subtraction the next greatest gain seems to be between the ages of 10 and 11, while in the case of addition the second greatest gain was between the ages of 12 and 13. The smallest gain is made between the ages of 12 and 13.

CONCLUSIONS

1. The conclusions reached in regard to addition (p. 39) hold in the case of subtraction.

2. Improvement in addition does not necessarily carry with it proportionate ability to subtract.

Section 3. Multiplication

The data presented in multiplication are from the same sources as those for addition and subtraction, and the method of treatment has been the same throughout.

Table XXI gives the facts in regard to multiplication in the Madison County 6-month schools.

TABLE XXI

Age Distribution, 10 to 13 Inclusive, of Courtis Series B Arithmetic Tests Multiplication Rights in the 6-Month White Schools of Madison County, Ky.

Age	Scores																				Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	X9	X10	X11	
10	9	19	82	16	3	5	4	1	1	----	----	----	----	----	----	----	----	----	----	----	----	140
11	8	9	75	11	11	8	2	2	----	----	----	----	----	----	----	----	----	----	2	----	----	124
12	4	6	62	12	16	12	9	3	4	1	----	----	----	----	----	----	----	1	4	2	----	136
13	2	4	57	15	8	9	5	3	----	1	4	----	----	----	----	----	----	----	10	4	----	124

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.51	.04	.93	.08	.42	M11—M10=.11	.036
11	.62	.05	1.27	.21	.53	M12—M11=.31	.094
12	.93	.14	3.16	.38	1.39	M13—M12=.05	.142
13	.98	.18	3.77	.43	1.67	M13—M10=.47	.111

The median of each of the age-groups given falls below 1, and even the 75 percentile of the 10-year-old group falls between 0 and 1. It seems that most of the children in these schools below the age of 14 have an ability in multiplication that is less than can be measured by the Courtis Standard Research Tests in Arithmetic Series B.

The total gain in ability to multiply during the three-year period, ages 10 to 13 inclusive, is only .47. The P.E. of this statement of gain is .111, something over 25 per cent of the gain itself. The gain noted is very slight. Apparently these 6-month schools in Madison County are failing to teach most of the pupils under 14 how to multiply.

The improvement from year to year necessarily is very slight, since the total improvement is so small. From ages 10 to 11 the improvement is .11; from ages 11 to 12 it is .31; and from ages 12 to 13 it is .05. The greatest gain in any one-year period is .31 from ages 11 to 12.

The results of instruction in multiplication in these schools are very meager.

TABLE XXII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN THE 9-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	X9	X10	X11	
10	9	16	37	4	12	14	10	12	6	----	----	----	----	----	----	----	----	120
11	1	9	31	10	7	7	12	11	4	----	----	3	----	----	1	----	----	96
12	3	1	32	14	14	23	16	10	9	3	2	----	2	----	1	1	----	131
13	4	3	13	10	11	11	9	12	11	5	----	----	----	2	8	1	1	101

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.94	.21	3.85	.13	1.86	M11—M10= .76	.206
11	1.70	.26	4.58	.45	2.06	M12—M11=1.36	.200
12	3.06	.20	4.56	.87	1.84	M13—M12= .80	.216
13	3.86	.29	6.25	1.52	2.36	M13—M10=2.92	.222

Table XXII gives the facts in regard to multiplication in the 9-month schools of Madison County.

The median ability in multiplication in these schools for 10-year-old children is .94; a little less than 1. The 25 percentile of the 10-, 11- and 12-year-old groups is less than 1 in each case. The situation here presented is materially better than that in the 6-month schools.

The total gain in ability to multiply for the three-year period from ages 10 to 13 inclusive is 2.92. The contrast between this gain and that in the 6-month schools (.47) is marked. The P.E. of this gain of 2.92 is .222, a little over 7 per cent of the gain. The probable actual deviation of the true from the obtained measure is greater in the case of the 9-month schools than in the case of the 6-month schools, but in proportion to the gain made it is much less.

The improvement in ability to multiply from ages 10 to 11 is .76; from ages 11 to 12 it is 1.36; and from ages 12 to 13 it is .80. The gain during any one of the year periods is much greater than the gain for the entire three-year period in the 6-month schools. The greatest gain is from ages 11 to 12, as is the case in the 6-month schools.

Tables XXIII to XXVII inclusive give comparative data in regard to multiplication from other school systems. In the following summary the total improvement in ability to multiply during the three-year period from ages 10 to 13 inclusive is given for each of the school systems studied, and also the median ability for the respective groups of 13-year-old children. The schools are listed in the order of amount of improvement made.

TABLE XXIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN CERTAIN WHITE SCHOOLS IN LOUISVILLE, KY.

Age	Scores																				Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
10	10	16	43	7	15	23	34	32	30	26	21	12	5	7	3	----	----	----	----	----	----	284
11	5	10	16	10	8	11	17	37	41	36	35	32	21	14	3	7	5	1	----	----	----	309
12	----	5	10	2	9	11	18	31	34	38	35	41	34	15	17	9	6	2	----	2	1	320
13	----	----	5	3	3	9	18	22	32	43	40	38	34	18	13	13	8	2	4	----	----	305

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	3.82	.21	6.11	.28	2.91	M11—M10=2.16	.158
11	5.98	.14	8.17	4.00	2.08	M12—M11=1.07	.127
12	7.05	.15	9.17	4.80	2.18	M13—M12= .38	.120
13	7.43	.14	9.46	5.50	1.98	M13—M10=3.61	.152

TABLE XXIV

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN CERTAIN WHITE SCHOOLS IN LOUISIANA

Age	Scores																		Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	X9	X10	X11	
10	24	42	61	69	24	21	21	12	8	4	2	----	----	----	----	----	----	----	----	289
11	13	24	43	63	31	30	26	16	11	9	7	4	1	----	----	1	1	----	----	280
12	7	13	24	74	36	28	34	34	21	12	5	6	3	----	----	1	1	1	----	300
13	----	7	13	50	33	35	25	27	23	17	16	3	2	3	1	1	17	1	1	275

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P.E.
10	.23	.06	1.85	0.00	.92	M11—M10= .72	.080
11	.95	.12	3.23	0.00	1.61	M12—M11= .93	.106
12	1.88	.13	4.26	.41	1.92	M13—M12=1.10	.136
13	2.98	.17	5.70	.97	2.86	M13—M10=2.75	.117

TABLE XXV

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN ARKANSAS CITY

Age	Scores																	Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	X9	
10	14	51	61	63	44	24	24	11	6	----	----	----	----	----	----	----	----------	298
11	8	14	51	41	21	40	22	21	15	9	6	2	8	----	----	----	----------	258
12	4	8	14	49	25	38	50	31	22	28	16	2	4	2	1	2	----------	296
13	1	4	8	30	18	22	24	30	22	28	16	24	4	3	6	4	1	245

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.36	.06	1.78	0.00	.89	M11—M10=1.35	.098
11	1.71	.14	3.84	0.00	1.92	M12—M11=1.49	.127
12	3.20	.15	5.13	.97	2.08	M13—M12=1.31	.150
13	4.51	.19	6.88	2.01	2.43	M13—M10=4.15	.126

TABLE XXVI

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN SALINA, KAN.

Age	Scores																									Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	X9	X10	
10	16	22	48	31	27	20	23	48	48	24	10	9	4	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	334
11	3	16	22	19	17	22	23	21	52	22	8	10	17	4	5	2	--	2	1	1	--	--	--	--	--	--	--	--	267
12	3	3	16	8	8	11	29	29	45	51	19	33	27	19	19	3	7	1	--	--	--	--	--	--	--	--	2	--	333
13	--	1	3	6	8	13	11	31	27	46	29	28	19	10	15	7	4	8	--	--	2	--	--	--	--	2	4	2	275

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	3.13	.18	5.32	0.00	2.66	M11—M10=1.41	.155
11	4.54	.18	6.23	1.39	2.44	M12—M11=1.64	.148
12	6.28	.16	8.84	4.18	2.33	M13—M12= .53	.156
13	6.81	.20	9.18	4.86	2.66	M13—M10=3.68	.162

TABLE XXVII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS MULTIPLICATION RIGHTS IN HIBBING, MINN.

Age	Scores																					Total
	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	X9	X10	
10	18	35	34	23	29	35	20	21	16	12	9	5	4	1	1	--	--	--	--	--	--	--	261
11	--	16	19	11	24	25	23	42	25	19	10	15	8	1	2	2	1	--	1	--	--	--	244
12	--	--	7	10	12	17	27	29	27	26	18	18	10	3	9	6	1	4	1	1	4	--	230
13	--	--	3	6	4	12	12	13	13	17	16	11	12	12	8	3	--	2	--	--	33	4	181

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	2.77	.18	5.17	.41	2.38	M11—M10=2.32	.140
11	5.09	.17	6.92	2.62	2.15	M12—M11=1.39	.140
12	6.48	.18	8.97	4.42	2.27	M13—M12=2.17	.220
13	8.65	.32	12.59	5.63	3.48	M13—M10=5.88	.220

As is the case in addition and subtraction, the ranking in order of gain made in ability for the three-year period from ages 10 to 13 inclusive does not correspond exactly with the ranking in order of ability of

SCHOOL SYSTEMS	TOTAL GAIN	MEDIANS
	10 to 13 inclusive	13-year-old children
Hibbing	5.88	8.65
Arkansas City	4.15	4.51
Salina	3.68	6.81
Louisville	3.61	7.43
Madison County, 9-month schools	2.92	3.86
Louisiana	2.75	2.98
Madison County, 6-month schools	.47	.98

13-year-old children. The measure of gain made is probably the more significant measure, as for addition and subtraction.

It must be borne in mind that the steps of improvement are not necessarily of equal value. It may be more difficult to teach a child who cannot multiply to multiply well enough to do one example correctly than it is to teach a child who can do one example correctly to do two examples correctly. In other words, because Hibbing makes twice as much improvement as Louisiana does not necessarily mean that the teaching in Hibbing is twice as good as that in Louisiana. This difficulty in evaluating the results of this test is not due to the fact that a difference between the median abilities of age-groups is used as a measure, but rather to the manner in which the test is constructed. The unit in which the result is stated is not one of the relative difficulty with which those results are obtained.

The following summary shows the gain for each yearly age period in the systems studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Hibbing	2.32	1.39	2.17
Arkansas City	1.35	1.49	1.31
Salina	1.41	1.64	.53
Louisville	2.16	1.07	.38
Madison County, 9-month schools	.76	1.36	.80
Louisiana	.72	.93	1.10
Madison County, 6-month schools	.11	.31	.05
Total	8.83	8.19	6.34

The variations in amount of yearly gain are as great as they are in addition and subtraction. The greatest gain seems to be between ages 10 and 11 in this case, while in both addition and subtraction the greatest gain seems to come between ages 11 and 12. The smallest gain appears between ages 12 and 13.

The conclusions in regard to multiplication are the same as those for addition (p. 38) and subtraction (p. 44).

Section 4. Division

The data presented in division are from the same sources as those for addition, subtraction and multiplication, and the same method of treatment has been followed.

Table XXVIII gives the facts in regard to division in the 6-month schools of Madison County.

TABLE XXVIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN THE 6-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores													Total
	X1	X2	0	1	2	3	4	5	6	7	8	X9	X10	X11	
10	10	17	98	7	4	1	2	----	----	----	----	----	----	----	139
11	6	10	83	15	1	5	2	1	----	1	----	2	----	----	126
12	3	6	78	16	9	7	6	4	1	----	2	4	2	----	138
13	2	3	70	16	8	5	1	----	1	----	----	11	4	2	123

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.43	.03	.78	0.07	.35	M11—M10= .13	.028
11	.56	.04	.94	.18	.38	M12—M11= .20	.053
12	.76	.09	2.05	.32	.86	M13—M12= .04	.078
13	.80	.10	2.15	.36	.89	M13—M10= .37	.072

In these schools the median ability in division of each of the age-groups from ages 10 to 13 inclusive is between 0 and 1. For the ages 10 and 11 the 75 percentiles are in the same interval. It seems that in division, as in multiplication, the majority of the children under 14 years of age in the Madison County 6-month schools are unable to work correctly any of the examples given in the Courtis Standard Research Tests in Arithmetic Series B for division.

The total gain in ability to divide during the three-year period from ages 10 to 13 inclusive is from .43, the median for the 10-year-old children, to .80, the median for the 13-year-old children, a difference of .37. The P.E. of this difference is .072—about 20 per cent of the gain. This gain is very small for so long a period of time at the age when material progress is being made in this ability in other school systems.

As would be expected where the total improvement is so small, the yearly gains are very small and uneven. From ages 10 to 11 the gain is .13; from ages 11 to 12 it is .20; and from ages 12 to 13 it is .04. The P.E. of the gain from ages 12 to 13 is .072, which is almost twice as much as the gain. This means that the gain in this year is almost negligible.

Table XXIX gives the facts in regard to division in the Madison County 9-month schools.

TABLE XXIX

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN THE 9-MONTH WHITE SCHOOLS OF MADISON COUNTY, KY.

Age	Scores																		Total
	X1	X2	0	1	2	3	4	5	6	7	8	9	10	11	12	13	X9	X10	X11	
10	9	16	60	5	8	5	9	4	3	1	1	1	1	----	1	----	----	------	------	124
11	1	9	46	6	11	3	7	2	2	2	4	1	1	----	----	----	1	------	------	96
12	3	1	45	13	9	10	13	11	8	8	2	1	1	2	----	----	1	1	------	129
13	5	3	17	15	8	11	7	6	6	3	3	3	1	----	----	1	8	1	1	99

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.61	.12	2.37	.11	1.13	M11—M10= .21	.122
11	.82	.16	2.90	.30	1.30	M12—M11=1.45	.190
12	2.27	.21	5.31	.63	2.34	M13—M12= .86	.264
13	3.13	.33	6.37	.98	2.69	M13—M10=2.52	.210

In these schools the 25 percentile of each of the age-groups from ages 10 to 13 inclusive falls between 0 and 1, and the medians for the 10- and 11-year-old groups each fall in the same interval. A much larger proportion of the children reported are able to work some of the examples correctly than is the case in the 6-month schools.

The total gain from ages 10 to 13 inclusive in this case is 2.52 as against .37 in the case of the 6-month schools in the same county. The P.E. of the gain for the 9-month schools is .21, about 8.5 per cent of the gain. The probable actual deviation of the true measure of gain from the measure of gain given is almost three times as great as the like probable deviation in the case of the 6-month schools, but the gain in the case of the 9-month schools is so much greater that proportionately the probable deviation is smaller.

As in the 6-month schools, so in these, the yearly gains are unequal. From ages 10 to 11 the gain is .21; from ages 11 to 12 it is 1.45; and from ages 12 to 13 it is .86. The gain for each year after the first is much greater than the total gain in the 6-month schools for the entire three-year period.

Tables XXX to XXXIV inclusive give comparative data from other school systems in regard to division. In the following summary the total gain in ability to divide during the three-year period from ages 10 to 13 inclusive is given for each of the systems studied, and also the median ability of the 13-year-old children in the respective systems. The schools are listed in the order of the amount of improvement made.

In this table it is interesting to note that the ranking in order of amount of total gain corresponds exactly to ranking in order of the

TABLE XXX

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN CERTAIN WHITE SCHOOLS OF LOUISVILLE, KY.

Age	Scores																											Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	X9	
10	10	16	43	30	24	31	24	32	21	20	13	9	11	3	3	4	2	--	1	--	--	--	--	--	--	--	--	--	--	297
11	5	10	16	23	12	16	23	28	25	22	20	18	19	21	12	12	9	7	3	3	2	1	1	--	--	--	--	1	--	308
12	--	5	10	16	12	15	18	22	22	23	27	27	23	23	10	17	11	12	9	3	6	4	3	--	--	--	--	1	--	319
13	--	--	5	11	9	13	16	13	21	34	23	30	25	26	25	18	13	6	12	6	2	--	2	--	--	--	--	--	26	336

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	2.82	.19	5.60	.17	2.71	M11—M10=3.02	.192
11	5.84	.24	9.68	2.68	3.50	M12—M11=1.77	.204
12	7.61	.23	10.83	4.17	3.33	M13—M12=1.15	.191
13	8.76	.21	12.05	5.80	3.12	M13—M10=5.94	.176

TABLE XXXI

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN CERTAIN WHITE SCHOOLS IN LOUISIANA

Age	Scores																				Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	X9	X10	X11	
10	24	43	59	106	16	17	9	4	4	2	--	1	1	--	--	--	--	--	--	--	--	286
11	14	24	43	90	27	19	16	16	9	7	6	3	3	1	2	--	--	2	1	--	--	282
12	7	14	24	103	32	31	22	23	13	8	7	8	7	1	--	1	1	1	1	1	--	305
13	--	7	14	75	37	18	15	26	22	13	10	12	6	4	3	--	1	--	16	1	1	281

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.16	.02	.83	0.00	.33	M11—M10= .50	.060
11	.66	.09	2.70	0.00	1.35	M12—M11= .48	.092
12	1.14	.12	3.80	.30	1.75	M13—M12=1.27	.138
13	2.41	.19	5.85	.65	2.60	M13—M10=2.25	.120

TABLE XXXII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN ARKANSAS CITY

Age	Scores																				Total
	X1	X2	X3	0	1	3	3	4	5	6	7	8	9	10	11	12	13	14	15	X9	
10	16	49	60	86	43	22	9	7	2	--	--	--	1	--	--	--	--	--	--	--	295
11	8	16	49	81	38	10	16	9	9	6	5	7	1	2	--	--	--	--	--	--	257
12	4	8	16	82	45	37	19	19	11	15	12	6	10	9	--	--	1	--	--	--	294
13	1	4	8	42	29	25	23	19	25	23	15	5	8	10	5	1	3	--	1	1	248

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.26	.04	1.23	0.00	.61	M11—M10= .42	.053
11	.68	.08	2.07	0.00	1.03	M12—M11=1.14	.102
12	1.82	.14	4.50	.55	1.97	M13—M12=1.83	.150
13	3.85	.20	6.43	1.24	2.59	M13—M10=3.39	.121

TABLE XXXIII

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN SALINA, KAN.

Age	Scores																												Total
	X1	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	X9	X10	
10	16	21	47	48	41	39	27	28	21	21	9	12	2	..	2	1	..	..	..	..	..	..	..	..	..	..	..	..	....	....	335
11	3	16	21	36	21	29	37	17	29	16	16	25	7	5	4	4	5	2	..	2	..	..	..	..	..	..	..	2	....	....	297
12	3	3	16	22	18	28	25	32	33	29	25	28	9	21	8	10	5	2	1	2	..	..	..	..	..	..	..	..	2	....	322
13	....	3	3	11	17	20	27	25	29	31	14	20	11	18	14	8	10	2	..	2	..	..	1	..	..	2	..	..	5	2	275

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	1.86	.15	4.43	0.00	2.21	M11—M10=1.74	.158
11	3.60	.21	6.85	.95	2.95	M12—M11=1.85	.176
12	5.45	.19	8.26	2.86	2.80	M13—M12=1.35	.176
13	6.80	.22	9.56	3.54	3.01	M13—M10=4.96	.166

TABLE XXXIV

AGE DISTRIBUTION, 10 TO 13 INCLUSIVE, OF COURTIS SERIES B ARITHMETIC TESTS DIVISION RIGHTS IN HIBBING, MINN.

Age	Scores																												Total
	X2	X3	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	X9	X10	
10	16	35	98	11	14	11	17	11	12	11	4	4	5	1	5	2	..	1	..	..	..	....	....	....	....	....	....	....	....	....	258
11	....	16	60	22	21	16	13	15	13	13	11	10	12	7	9	1	1	..	1	1	..	1	....	....	....	....	....	....	....	....	243
12	....	....	28	10	20	12	26	19	18	13	14	16	13	4	13	3	3	5	3	..	2	....	....	1	1	....	....	1	4	....	229
13	....	....	14	10	4	4	11	8	9	13	12	9	10	5	10	8	6	2	..	1	2	1	2	....	1	....	....	....	32	4	178

	Median	P. E. true —obtained median	75 per-centile	25 per-centile	Q		P. E.
10	.79	.17	4.50	.13	2.18	M11—M10=2.36	.172
11	3.15	.27	7.48	.74	3.37	M12—M11=2.82	.220
12	5.97	.27	9.73	2.96	3.38	M13—M12=3.47	.327
13	9.44	.45	15.12	5.18	4.92	M13—M10=8.65	.172

size of the median for the 13-year-old children. This is not true in the case of addition, subtraction, or multiplication, though in each case there is a marked similarity in the ranking.

SCHOOL SYSTEMS	TOTAL GAIN	MEDIANS
	10 to 13 inclusive	13-year-old children
Hibbing	8.65	9.44
Louisville	5.94	8.76
Salina	4.96	6.80
Arkansas City	3.39	3.65
Madison County, 9-month schools	2.52	3.13
Louisiana	2.25	2.41
Madison County, 6-month schools	.37	.80

The following table shows the yearly gain in ability to divide in each of the systems studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Hibbing	2.36	2.82	3.47
Louisville	3.02	1.77	1.15
Salina	1.74	1.85	1.35
Arkansas City	.42	1.14	1.83
Madison County, 9-month schools	.21	1.45	.86
Louisiana	.50	.48	1.27
Madison County, 6-month schools	.13	.20	.04
Total	8.38	9.71	9.97

The variations in amount of yearly gain in the different systems is as great as it is in addition, subtraction and multiplication. The greatest gain seems to be between ages 12 and 13, but the gain from ages 11 to 12 is almost as great. The gain from ages 10 to 11 is somewhat less. It seems that division is taught when the children are a little older than when addition, subtraction and multiplication are taught.

CONCLUSIONS

1. The difference in performance in arithmetic, as measured by the Courtis Standard Research Tests in Arithmetic, can be obtained for school children of different ages.

2. Since the fundamental processes measured by this test are largely, if not solely, imparted by school training, this difference is a reliable measure of school efficiency.

3. Since the improvement measured by this test is stated in terms of examples solved in a given time rather than in terms of difficulty for the children, the differences obtained must be considered in connection with the number of examples solved by the groups of children of different ages.

4. The differences obtained may be compared for two systems of schools, even though the testing was done at different times in the respective systems.

5. The differences obtained are valid, even though there are constant errors in the giving of the tests, such as might be caused by having the tests given by the teachers.

6. Material gain may be made in these fundamental processes of arithmetic during any part or all of the age period from 10 to 13 inclusive.

7. The results in the 6-month schools of Madison County, Kentucky, are uniformly poorer than in any of the other systems studied.

CHAPTER V

ACHIEVEMENT AS MEASURED BY THE THORNDIKE SILENT READING SCALE ALPHA 2

THE Thorndike Silent Reading Scale Alpha 2 was used to measure reading in the schools of Madison County at the same time that the tests were given in Language and Arithmetic. This scale is designed to be used as a group test, and the directions for scoring are given on the basis of groups of pupils such as would be found in one room of a city school system. In country schools such groups do not exist, and therefore individual scores were assigned each pupil, on the basis of tables prepared by Dr. Truman Lee Kelley.[1]

Using the individual scores assigned on the basis of these tables, the remaining problems involved in finding the differences in performance in reading of different age-groups are practically the same as in the work with the Trabue Language Scale and the Courtis Standard Research Tests in Arithmetic. Distributions for the respective age-groups are completed on the same assumptions, and the same age-groups are used throughout. Scores used are in terms of difficulty as assigned by Thorndike.

Table XXXV gives the facts in regard to reading in the Madison County 6-month schools. The table reads, there are estimated to be 8 children 10 years old in the first grade (X1) whose scores in reading are unknown, 10 children 10 years of age with scores unknown are estimated to be in the second grade (X2), 1 child 10 years old made a score of 2.0, 5 made a score of 2.2, 3 a score of 2.6, 3 a score of 2.9, 2 a score of 3.2, etc.

The total gain in ability to read for the three-year period from ages 10 to 13 inclusive is from 4.50 to 5.26, a difference of .76. The P.E. of this difference is .09, or about 12 per cent of the total. This gain is very small for a three-year period, and the P.E. of the gain is relatively quite large.

The improvement from year to year is very uneven. From ages 10 to 11 it is .03; from ages 11 to 12 it is .59; and from ages 12 to 13 it is .14. The results indicate rather indefinite work in reading.

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[1] Kelley, T. L.: "Thorndike's Reading Scale Alpha 2 Adapted to Individual Testing," *Teachers College Record*, XVIII: 253*ff*. (May, 1917).

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Table XXXVI gives the facts in regard to reading in the 9-month schools of Madison County.

The total gain for the three-year period in this case is from 4.55, the median ability of the 10-year-old children, to 6.45, the median ability of the 13-year-old children, a difference of 1.90. This gain is just 2.5 times as great as that made in the 6-month schools of the same county. The median abilities of the 10-year-old children are about alike. The comparison of amount of gain in the two cases is valid, since the scores given are in terms of difficulty for the children. It must be remembered, however, that there is no proof that the gain in each case can be attributed solely to school work. It is possible that influences outside of the school contribute materially to the result. The conclusion can only be that school influence on reading and other possible influence on reading accomplish between them 2.5 times as much in places having a 9-month school term as do the same influences in places having a 6-month school term.

The P.E. of the gain in the 9-month schools (1.90) is .12, about 7 per cent of the gain. The probable actual deviation of the true difference from the obtained difference in these schools is a little larger than the like deviation in the 6-month schools, but in proportion to the gains made in the respective schools the deviation is less in the 9-month schools.

The yearly gains are much more nearly uniform than in the 6-month schools. From ages 10 to 11 the gain is .75; from ages 11 to 12 it is .56; and from ages 12 to 13 it is .59.

Tables XXXVII to XXXIX inclusive give comparative data in regard to reading from certain other school systems. The data from Louisville are based upon tests given by the Psychological Laboratory of the Louisville Board of Education. Data for Hamilton Township, New Jersey, were collected by the Psychology Department of the Trenton State Normal School. The data from Amsterdam, New York, were collected by the Department of Educational Administration of Teachers College, Columbia University.

In the following summary the total improvement in silent reading during the three-year period from ages 10 to 13 inclusive is given for each of the school systems studied, and also the median ability for the respective groups of 13-year-old children. The schools are listed in the order of the amount of improvement made.

School Systems	Total gain	Medians
	10 to 13 inclusive	13-year-old children
Amsterdam	2.85	6.55
Madison County, 9-month schools	1.90	6.45
Louisville	1.81	6.90
Hamilton Township	1.58	6.77
Madison County, 6-month schools	.76	5.25

The ranking in order of amount of improvement for the three-year period from ages 10 to 13 inclusive does not correspond exactly with the ranking in order of ability of 13-year-old children. As has been pointed out in the case of language and arithmetic, the medians for 13-year-old children may be affected by constant errors in any of the respective systems, such as a tendency to overrun the time allowance, a little greater leniency in scoring papers in one place than in another either by the teachers or by the examiner, in giving directions, etc. Such errors are compensating when the difference between the medians for two ages is used as a measure, since these errors would be constant for any given place and time for pupils of the different ages. In view of this, it is probable that the ranking in order of total gain in the above table is the more significant ranking.

The amount of gain in the respective systems is directly comparable, since the scale used is expressed in terms of units of difficulty for the children. We can say that the results in Amsterdam for the three-year period from 10 to 13 inclusive are about four times as good as are the results in the Madison County 6-month schools, and about twice as good as the results in Hamilton Township. However, not all of the improvement noted is known to be the result of school procedure. A good share of the gain in ability to read silently may be due to forces outside of the school, such as library facilities, home influence, newspapers, etc. Indeed, it is sometimes charged that school work in reading stresses oral work too much.[1] The conclusion from the above table is therefore limited to the statement that the sum of school influence in reading and outside influences in reading is about four times as great in Amsterdam as in the Madison County 6-month schools for the equal period of time from ages 10 to 13. If equality of outside influences making for improvement in silent reading might be assumed for the different systems studied, there would be left the single variable element in the school work on silent reading. It does

[1] For an example of this see Klapper, *Teaching Children to Read.*

not seem probable, however, that influences other than those of the school which make for improvement in silent reading are equal in cases such as Amsterdam, New York, and the smaller schools of Madison County, Kentucky.

The following summary shows the gain for each age period of a year in the systems studied:

School Systems	Yearly Gains		
	10 to 11	11 to 12	12 to 13
Amsterdam	1.67	.62	.56
Madison County, 9-month schools	.75	.56	.59
Louisville	.94	.42	.45
Hamilton Township	.72	.34	.52
Madison County, 6-month schools	.03	.59	.14
Total	4.11	2.53	2.26

The variations in the amount of yearly gain are large, as is the case in language and arithmetic. The greatest gain seems to be from ages 10 to 11, and each year after this shows less gain than the preceding year. It appears that greater gain is made by younger children than by older ones within the limits of the age-groups studied.

CONCLUSIONS

1. The difference in ability in silent reading, as measured by the Thorndike Silent Reading Scale Alpha 2, can be obtained for children of different ages.

2. Since the function measured by this scale may be improved by influences outside of the school, as well as by school training, this difference cannot be considered as a wholly reliable measure of school efficiency in teaching silent reading.

3. This difference does give a reliable measure of the improvement in silent reading due to all causes during the three-year period from ages 10 to 13 inclusive.

4. Since the improvement measured by this scale is stated in terms of difficulty for the children, the differences obtained in the respective systems studied may be compared directly.

5. The differences obtained may be compared for two systems of schools, even though the testing was done at different times in the respective systems.

6. The differences obtained are valid, even though there may be constant errors in the giving of the tests, such as might be caused by having the tests given by the teachers.

7. Greater gain in silent reading seems to be made by the younger children within the age limits studied (ages 10 to 13 inclusive).

8. Material gain in silent reading may be made during any part or all of the period from ages 10 to 13 inclusive.

9. The results in the Madison County 6-month schools are much poorer than in any other system studied.

10. The results in the Madison County 9-month schools compare favorably with those in the other systems studied.

CHAPTER VI

SUMMARY AND CONCLUSIONS

THIS study was undertaken with four specific objects in mind. These objects are set forth in Chapter II, and are stated as follows:

First: To show that the difference in performance in school subjects of children of different ages can be obtained.

Second: To show that this difference is a measure of school efficiency which may be used to measure schools or school systems.

Third: To apply this measure to a system of country schools.

Fourth: To compare the results in this country school system with the results in certain city school systems.

The results of the study are considered in the light of these aims. Sections 1, 2, 3 and 4 of this chapter deal respectively with the purposes stated.

SECTION 1

The purpose as stated is "to show that the difference in performance in school subjects of children of different ages can be obtained."

With the tests used such differences have been obtained for children from 10 to 13 years of age inclusive. As the work progressed, certain difficulties became apparent which seem to justify the following statements:

The tests to be used in obtaining age differences in performance must be of such a nature that identical tests can be given in identical manner to all of the grades tested. Such a spelling scale as that devised by Ayres could not give age differences because the 12-year-old child in the third grade would have a score on a test different from the test used for the 12-year-old child in the sixth grade. The results for children of like age, but in different grades, would be in terms that could not be directly compared.

The tests should be given in as many as possible of the grades of the elementary school. The tabulations in this study include results for grades 3 to 8 inclusive and in some cases for grades 4 to 8. With results from children in these grades it was found necessary to estimate the number of children in the lower grades of the respective ages studied, and it seemed unwise to attempt to find medians for

groups of children under 10 years of age because of the limited number of children of the lower ages tested. If the tests could have been given in grade 2, it would have been possible to calculate medians for children under 10, and the necessity of calculating the probable number of 10-to-11-year-old children in grade 2 would have been avoided, and scores could have been assigned them.

Full age-grade tables of all the children in all the grades of the systems studied should be prepared. Such tables give a very desirable check on the number of children tested, and furnish a basis for estimation of the number of children of any given age in grades not tested.

Tests used should be such as will test the ability of the children in the lower grades as well as the ability of those in the higher grades. The work with Courtis Standard Research Tests in Arithmetic showed that these tests do not measure the ability of lower grade children, since a great many children were unable to work correctly even one of the examples given. A test that includes problems less difficult than those of this series would be desirable.

Tests used must be individual tests rather than group tests; at least it must be possible to assign individual scores on the basis of the tests given. This is necessary in order that the individual scores of children of any given age may be taken from the different grades in which these children are tested and thrown into a single distribution on an age basis.

For work in country schools there is an added need for individual tests rather than group tests, since groups of children of like age or grade in any given country school are likely to be small.

The above statements may be summarized as a set of directions for the guidance of those giving tests which are to be tabulated on an age basis. The concise directions are as follows:

1. Select tests that are identical for all the grades to be tested.
2. Test as many of the grades as possible.
3. Make full age-grade tables of all the children in all the grades.
4. Select tests that measure the ability of all the children.
5. Use individual rather than group tests.

Section 2

The second purpose of this study as stated is "to show that this difference is a measure of school efficiency which may be used to measure schools or school systems."

In so far as the tests used measure functions affected solely, or even

largely, by school training, the difference in performance of children of different ages seems to furnish a measure of school efficiency. In the case of the Trabue Language Scale B the function measured has not been shown to be fundamentally one dependent on school training. In the case of the Courtis Standard Research Tests in Arithmetic Series B it seems that the function measured is to a very large degree at least one dependent on school training; therefore in this case the difference obtained is one that is chiefly the direct result of the school training received by the children and of elimination, and for that reason may be considered a measure of the effectiveness of that training and of elimination. In the case of the Thorndike Silent Reading Scale Alpha 2 the function measured is one which is greatly affected by school training, but which may also be greatly affected by influences outside of the school.

Even though the function measured be one which is affected by influences other than school training, it may be argued that the work of the school should so supplement other influences brought to bear upon the children as to secure for them reasonable development of the function considered. If this conception of the work of the school is accepted, the difference between performance of children of different ages seems a sound measure of the degree to which the school has succeeded in its effort to secure the desired development.

In any case in which the difference in performance of children of different ages is considered as measuring some function other than one dependent on school training for its improvement, the difficulty lies in the nature of the test rather than in the fact that the age-differences are used. The same criticism would apply to the same measurement if grade standards were used.

There are a few advantages that the use of age-differences as a measure of school efficiency seems to have over the use of grade standards. One of these is that the testing may be done at any convenient time in the school year, with the possible exception of the first three or four weeks of the school term. This is due to the fact that the birthdays of any age-group of children, say the 10-year-olds, are distributed throughout the year in the same way as are the birthdays of any other age-group, say the 13-year-olds. This means that the loss of children from the group because they reach a higher age will be compensated by the accretion of other children from the next lower age-group. Moreover, this loss and accretion continues throughout the school year and for each age-group, so that the difference between

any two age-groups is a constant quantity. During the first few weeks of school there may be a slightly uneven loss in school ability due to the vacation period, since it has never been shown that the retaining power of children of different ages is the same. After school is once well under way this uneven loss is overcome, and the testing may be done at any convenient time.

Another advantage in the use of age-differences as a measure of school efficiency lies in the fact that errors such as those caused by having the tests given by the teachers are compensated, since such errors are identical for children of all ages.

A further advantage in the use of age-differences lies in the fact that the effects of poor grading or great retardation are considered in the measurement of improvement. The necessity of correcting grade results for retardation is avoided, since the score of the retarded child of any given age has entered into the measurement of that age-group.

The advantages mentioned above are of particular significance for work in country schools. The difficulties involved in giving tests where the schools are scattered, the grading poor, and the groups of children frequently very small, make it especially desirable to give tests in these schools at the most convenient time of the year and to have the tests given by the teacher.

Section 3

The third purpose of this study as stated is "to apply this measure to a system of country schools."

This purpose has been accomplished and the results given in the treatment of the respective tests.

Section 4

The fourth purpose of this study as stated is "to compare the results in this country school system with the results in certain city school systems."

The Madison County 6-month schools have been compared throughout this study with the schools in the same county having a 9-month school term. In addition to this comparison, the results of the Trabue Language Scale B have been compared with results from Louisville, Kentucky; Paterson, New Jersey; and St. Paul, Minnesota. As has already been pointed out, this comparison concerns the results of school training and also other influences. The 9-month schools in Madison County made a gain in the ability to complete sentences 53

per cent greater than the gain made over the same three-year period in the 6-month schools. None of the systems studied made a gain so great as that of the Madison County 9-month schools, and all of them except St. Paul made gains greater than did the Madison County 6-month schools. St. Paul made practically the same gain as did these schools.

If the comparison is made on the basis of the final ability attained by the children (medians for 13-year-olds), the Madison County 6-month schools are poorer than any of the others studied. Louisville 13-year-old children possess 50 per cent greater ability to complete sentences than do those in the smaller schools of Madison County. The children of the same age in the 9-month schools possess 25 per cent greater ability than do the children of the 6-month schools. The 10-year-old children in Louisville possess greater ability to complete sentences than do the 13-year-old children in the 6-month Madison County schools, and so do the 12-year-old children in the 9-month schools, the 11-year-olds in Paterson and the 10-year-olds in St. Paul.

Whichever basis of comparison is used, the Madison County 6-month schools are at the bottom. If the age achievement is used as the basis of comparison, the Madison County 9-month schools are only kept from the bottom by the presence of the 6-month schools among the systems compared.

In comparing the work in arithmetic it must be remembered that the results are in terms of examples worked correctly in a given length of time, and that it cannot be assumed that it is twice as difficult to add 8 examples as it is to add 4 in the same time. Bearing in mind this caution, it seems, on the basis of the results obtained, that while the pupil in the Madison County 6-month schools is increasing his ability to add to such an extent that he can add one more example in the time allowed, the pupil in the Madison County 9-month schools is increasing his ability to add by 1.6 examples, the pupil in Louisiana by 2.2, the one in Arkansas City by 2.7, the one in Salina by 3.0, the one in Louisville by 3.4, and the one in Hibbing by 5.7 examples.

In subtraction the situation is much the same. While the pupil in the Madison County 6-month schools is improving his ability to subtract by 1 example, the one in the 9-month schools of the same county is improving his ability by 3.1, the one in Salina by 3.2, the one in Louisiana by 3.3, the one in Arkansas City by 4.2, the one in Louisville by 4.8, and the one in Hibbing by 5.8 examples.

While the pupil in the 6-month schools of Madison County is improving his ability to multiply to such an extent that he can multiply one more example in the time allowed, the pupil in Louisiana improves his ability so that he can multiply 5.8 more examples in the time allowed, the pupil in the Madison County 9-month schools improves by 6.2 examples, the one in Louisville by 7.7, the one in Salina by 7.8, the one in Arkansas City by 8.8, and the one in Hibbing by 12.5 examples.

In division the situation is even worse. While an improvement of one example is being made by the pupil in the Madison County 6-month schools, there is an improvement of 6.1 by the pupil in the Louisiana schools, of 6.8 in the Madison County 9-month schools, of 9.1 in Arkansas City, of 13.4 in Salina, of 16.1 in Louisville, and of 23.4 in Hibbing.

If the comparison be put on the basis of achievement of 13-year-old children, the situation in the Madison County 6-month schools does not seem to be much better. The median 13-year-old child in these schools can neither add, subtract, nor multiply as well as the median 10-year-old in Hibbing, and he can barely divide as well. The Madison County 9-month schools do better on this basis, but the median for the 13-year-old children is below the median for the 11-year-old children in Hibbing in addition, subtraction, multiplication and division.

The comparison of the results of the Thorndike Silent Reading Tests shows conditions which are not quite so disastrous for the Madison County 6-month schools in that the differences are not so great. On the basis of improvement, while the pupil in the Madison County 6-month schools is improving his ability to read by one step on the Thorndike scale, the pupil in Hamilton Township improves 2.1 steps, the one in Louisville 2.4, in the Madison County 9-month schools 2.5, and in Amsterdam 3.7 steps. On the basis of age achievement the median 13-year-old child in the Madison County 6-month schools is poorer than the median 11-year-old child in Hamilton Township, Louisville, and Amsterdam, and almost as poor as the median 11-year-old child in the Madison County 9-month schools.

The comparison of the Madison County 6-month schools with the other schools tested may be summed up in the statement that the children in these schools have less ability along every line tested than have the children of the same ages in other schools, and that they are learning more slowly, except that the children in St. Paul are improving as slowly as they do in language.

Final Summary

The following four statements seem justified concerning the four purposes for which this study was undertaken:

First: The difference in performance in school subjects can be obtained for children of different ages.

Second: This difference is a measure which may be used to measure schools or school systems, and has certain advantages for this purpose, especially in rural schools.

Third: This measure has been applied to a system of country schools.

Fourth: The Madison County 6-month schools compare unfavorably with all of the other schools measured. The Madison County 9-month schools compare more favorably.

APPENDIX

For the convenience of any who may wish to supplement the report made in Chapter I of scientific studies on the results of instruction in rural schools, or who may later wish to bring this report up to date, this statement of the educational literature investigated is made.

As a first step in searching for such data the following surveys were studied. In each case the tables showing the results were investigated to find what scores might be included from rural schools in the comparisons made.

SURVEYS

Akron, Ohio.
Alabama (three counties).
Alabama.*
Alton, Ill.
Amsterdam, N. Y.
Anderson, Ind.
Arizona.*
Ashland, Ore.
Atlanta, Ga.
Baltimore, Md.
Binghamton, N. Y.
Blaine, Wash.
Bloomington, Ind.
Boise, Idaho.
Boston, Mass.
Bridgeport, Conn.
Buffalo, N. Y.
Brookline, Mass.
Butte, Mont.
Chicago, Ill. (Educational Commission).
Cincinnati, Ohio.
Cleveland, Ohio.
Cleveland, Ohio.†
Colorado.
Cold Springs, N. Y. (Haldane School).
Colorado (rural schools).
Columbia, S. C.
Connecticut (Educational Commission).
Connecticut (counties).
Dansville, N. Y. (High School).
Dayton, Ohio.
Delaware.‡
Delaware (School Buildings).
Denver, Col.
Detroit, Mich. (Recreational).
Elyria, Ohio.*
Evansville, Ind. (Vocational).
Framingham, Mass.
Gary, Ind.*
Gary, Ind.‡
Georgia (Counties).
Grafton, W. Va.
Grand Junction, Col.
Grand Rapids, Mich.
Great Neck, L. I.
Greene County, Ind.
Greenwich, Conn.
Hammond, Ind. (Industrial).
Harrisburg, Pa.
Herkimer, N. Y.
Huron County.
Illinois (State).
Indiana (Vocational).
Janesville, Wis.
Jefferson County, Ind. (Vocational).
Kansas (high schools).

*United States Bureau of Education.
†Russell Sage Foundation.
‡General Education Board.

Lane County, Ore.
Los Angeles, Cal.
Leavenworth, Kan.
Louisville, Ky.
Maricopa County, Ga.
Maryland (State).‡
Memphis, Tenn.*
Minneapolis, Minn. (Vocational).
Missouri (Saline County).
Montclair, N. J.
Nassau County, N. Y.
Newburgh, N. Y.
New Orleans, La. (Vocational).
Newton, Mass.
New York City.
North Dakota.*
Oakland, Cal.
Ogden, Utah.
Ohio.
Oklahoma.
Oklahoma (county).
Oswego County, N. Y.
Paducah, Ky.
Paterson, N. J.
Port Townsend, Wash.
Portland, Ore.
Reading, Pa.
Rochester, Minn.
Rockford, Ill.
St. Louis, Mo.
St. Paul, Minn.
Salt Lake City, Utah.
San Antonio, Texas.
San Francisco, Cal.
San Mateo, Cal.
Saskatchewan, Canada.
Solvay, N. Y.
South Bend, Ind.
South Dakota.*
Stamford, Conn.
Syracuse, N. Y.
Travis County, Texas.
Utica, N. Y.
Van Wert, Ohio.
Vermont.†
Virginia (Educational Commission).
Washington.*
Waterbury, Conn.
Westchester, N. Y.
Wilmington, Del.*
Windsor County, Vt.
Wisconsin (State).
Winston-Salem, N. C.
Wyoming.*

The next step in the search for data bearing on the objective results of instruction in rural schools was a study of *A Selected Bibliography of Certain Phases of Educational Measurements,* prepared by Edna Bryner and published in the Seventeenth Year Book of the National Society for the Study of Education, 1918. The titles listed were examined, and whenever there seemed any possibility that the article might contain any data concerning country schools the article was studied. One bulletin by E. J. Ashbaugh, entitled *The Arithmetical Skill of Iowa School Children,* University of Iowa Extension Bulletin, No. 24, November, 1916, was not found. In all, twenty-eight of the references were examined, and of these five were found to contain data.

As a final step in the search for material bearing on the comparison of country and city schools by the use of objective standards, a study was made of the monthly lists of current educational publications pre-

*United States Bureau of Education.
†Russell Sage Foundation.
‡General Education Board.

pared by the United States Bureau of Education, beginning with the list for June, 1917, and extending through the list for October, 1920. In this study every title and subtitle was considered, and in case there seemed a possibility that objective data might be found, the reference was investigated. In this study only two articles which seemed to bear in any way on this topic were not found. These references are: (1) Johnson, W. E., "Reading, Writing, Arithmetic and Spelling in City and Town Schools of South Dakota in 1917-1918," *Bulletin of the Northern Normal and Industrial School at Aberdeen, S. D.*, Vol. XII, No. 2 (October, 1918); and (2) Heckert, J. W., "The Cleveland Survey Tests in Arithmetic in the Miami Valley," *Elementary School Journal,* XVIII: 447-457.

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